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# **UNITED STATES AIR FORCE ELMENDORF AIR FORCE BASE, ALASKA**

*ENVIRONMENTAL RESTORATION PROGRAM*

ENGINEERING EVALUATION/COST ANALYSIS  
SS83  
FINAL

**FEBRUARY 2002**





## CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS.....	vi
EXECUTIVE SUMMARY .....	E-1
1.0 INTRODUCTION.....	1-1
1.1 EE/CA Report Objectives.....	1-1
1.2 Cleanup Criteria.....	1-1
1.3 EE/CA Report Organization .....	1-2
1.4 Regional Setting .....	1-3
1.5 Site Description and Background.....	1-6
1.5.1 Site Location .....	1-6
1.5.2 Site History and Use .....	1-6
1.5.3 Site Features and Structures.....	1-8
1.5.4 Topography.....	1-12
1.5.5 Site Geology .....	1-13
1.5.6 Hydrogeology.....	1-14
1.5.7 Surrounding Land Use .....	1-19
1.5.8 Sensitive Ecosystems .....	1-19
1.5.9 Meteorology .....	1-20
1.6 Basewide Background Soil and Groundwater Data .....	1-20
1.6.1 Soil.....	1-20
1.6.2 Groundwater .....	1-22
1.7 Previous Investigations.....	1-23
1.7.1 Area Under Evaluation Study .....	1-23
1.7.2 Limited Field Investigation.....	1-23
2.0 SITE CHARACTERIZATION .....	2-1
2.1 EE/CA Field Investigation Program.....	2-1
2.1.1 Site Clearances/Permits.....	2-1
2.1.2 Brush Removal .....	2-2
2.1.3 Visual Inspection.....	2-2
2.1.4 Geophysical Survey .....	2-3
2.1.5 Test Pit Excavations .....	2-5
2.1.6 Soil Borings.....	2-6
2.1.7 Field Screening.....	2-7
2.1.8 Monitoring Well Installation .....	2-8
2.1.9 Groundwater Sampling .....	2-10
2.1.10 Field Quality Control Samples.....	2-10
2.1.11 Sample Management.....	2-11
2.1.12 Field Documentation .....	2-13
2.1.13 Field Equipment Calibration .....	2-15
2.1.14 Decontamination Procedures .....	2-15
2.1.15 Investigation-Derived Waste .....	2-16

**CONTENTS (Continued)**

2.1.16	Site Survey .....	2-20
2.2	Nature and Extent of Contamination .....	2-21
2.2.1	Drum Bunker Area .....	2-21
2.2.2	Large Foundation Area .....	2-26
2.2.3	Motor Pool Area .....	2-32
2.2.4	Suspected Landfill Area .....	2-44
2.2.5	Small Foundation Area .....	2-50
2.2.6	Bermed Bunker Area .....	2-60
2.2.7	Former Underground Bunker Area .....	2-63
2.2.8	Docking Area .....	2-65
2.2.9	Lookout Pad .....	2-70
2.2.10	Ravine Area .....	2-80
2.3	Streamlined Risk Evaluation .....	2-85
2.3.1	Risk Management Criteria .....	2-86
2.3.2	Conceptual Site Model .....	2-87
2.3.3	Risk-Based Screening .....	2-91
2.3.4	Cumulative Risk .....	2-92
2.3.5	Potential Ecological Risks .....	2-95
3.0	IDENTIFICATION OF REMOVAL ACTION OBJECTIVES .....	3-1
3.1	Summary of Statutory Limits on Removal Actions .....	3-1
3.2	Scope of Removal Action .....	3-1
3.3	Identification of ARARs and Other Criteria .....	3-2
3.4	Schedule for Removal Action .....	3-3
3.5	Summary of Removal Action Objectives .....	3-3
4.0	IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES .....	4-1
4.1	Identification of Alternatives .....	4-1
4.1.1	Alternative 1 – No Further Action .....	4-2
4.1.2	Alternative 2 – Institutional Controls .....	4-2
4.1.3	Alternative 3 – Removal with Disposal .....	4-3
4.1.4	Alternative 4 – Treatment .....	4-5
5.0	COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES .....	5-1
5.1	Effectiveness .....	5-1
5.2	Implementability .....	5-1
5.3	Cost .....	5-2
6.0	RECOMMENDATIONS AND CONCLUSIONS .....	6-1
6.1	Recommendations .....	6-1
6.1.1	Drum Bunker Area .....	6-1
6.1.2	Large Foundation Area .....	6-2
6.1.3	Motor Pool Area .....	6-2
6.1.4	Suspected Landfill Area .....	6-3

**CONTENTS (Continued)**

6.1.5	Small Foundation Area.....	6-4
6.1.6	Bermed Bunker Area .....	6-5
6.1.7	Underground Bunker Area .....	6-6
6.1.8	Ravine Area .....	6-6
6.1.9	Docking Area .....	6-6
6.1.10	Lookout Pad Area .....	6-6
6.2	Conclusions .....	6-7
7.0	REFERENCES.....	7-1

**APPENDICES**

A	GEOPHYSICAL SURVEY REPORT
B	TEST PIT LOGS
C	GEOTECHNICAL DATA
D	BORING LOGS AND WELL CONSTRUCTION DIAGRAMS
E	PHOTOGRAPHS
F	INVESTIGATION-DERIVED WASTE MANAGEMENT
G	DATA ASSESSMENT REPORT
H	VOLATILE ORGANIC COMPOUND DATA
I	ADEC METHOD ONE MATRIX SCORESHEET

## LIST OF TABLES

Table 1-1. Summary of Basewide Background Soil Concentrations for SS83 EE/CA Metallic Target Analytes.....	1-21
Table 1-2. Summary of Basewide Background Groundwater Concentrations for SS83 EE/CA Metallic Target Analytes. ....	1-22
Table 2-1. SS83 EE/CA Site Cleanup Levels.....	2-22
Table 2-2. Drum Bunker Area Soil Sample Analytical Results.....	2-25
Table 2-3. Large Foundation Area Surface Soil Sample Analytical Results.....	2-31
Table 2-4. Large Foundation Area Subsurface Soil Sample Analytical Results.....	2-33
Table 2-5. Large Foundation Area Groundwater Sample Analytical Results. ....	2-36
Table 2-6. Motor Pool Area Soil Sample Analytical Results. ....	2-41
Table 2-7. Motor Pool Area Groundwater Sample Analytical Results.....	2-45
Table 2-8. Land Fill Area Soil Sample Analytical Results. ....	2-51
Table 2-9. Small Foundation Area Soil Sample Analytical Results.....	2-55
Table 2-10. Small Foundation Area Groundwater Sample Analytical Results. ....	2-57
Table 2-11. Bermed Bunker Area Soil Sample Analytical Results.....	2-62
Table 2-12. Bermed Bunker Area Groundwater Sample Analytical Results. ....	2-64
Table 2-13. Underground Bunker Area Soil Sample Analytical Results.....	2-67
Table 2-14. Docking Area Soil Sample Analytical Results.....	2-72
Table 2-15. Lookout Pad/Subsurface Soil Sample Analytical Results. ....	2-74
Table 2-16. Lookout Pad Surface Soil Sample Analytical Results.....	2-77
Table 2-17. Lookout Pad Groundwater Sample Analytical Results.....	2-81
Table 2-18. Ravine Area Soil Sample Analytical Results. ....	2-84
Table 2-19. SS83 Cumulative Site Risk – Soil. ....	2-93
Table 2-20. SS83 EE/CA Streamlined Risk Evaluation – Cumulative Site Risk – Groundwater.....	2-96
Table 2-21. Comparison of Detected PAH Surface Soil Concentrations to Ecological Screening Criteria. ....	2-98
Table 5-1. SS83 EE/CA – Comparative Analysis of Removal Alternatives. ....	5-3

## LIST OF FIGURES

Figure 1-1. SS83 Site Location Map. ....	1-4
Figure 1-2. Regional Groundwater Flow Patterns. ....	1-5
Figure 1-3. SS83 Site Boundary. ....	1-7
Figure 1-4. SS83 Site Layout. ....	1-9
Figure 1-5. SS83 Sitewide Monitoring Well and Soil Boring Location Map. ....	1-15
Figure 1-6. SS83 Sitewide Monitoring Well and Soil Boring Location Map (Continued). ....	1-16
Figure 1-7. SS83 Groundwater Contour Map. ....	1-17
Figure 1-8. SS83 Groundwater Contour Map (Continued). ....	1-18
Figure 2-1. Drum Bunker Area Test Pit Sample Locations. ....	2-23
Figure 2-2. Large Foundation Area Soil Boring and Test Pit Sample Locations ....	2-27
Figure 2-3. Large Foundation Area PCB Sample Locations. ....	2-30
Figure 2-4. SS83 Groundwater Sample Results. ....	2-37
Figure 2-5. Motor Pool Area Soil Boring and Test Pit Sample Locations. ....	2-38
Figure 2-6. Motor Pool Area Cross-Section A-A' and Analytical Results. ....	2-46
Figure 2-7. Land Fill Area Test Pit and Bluff Sample Locations. ....	2-48
Figure 2-8. Small Foundation Area and Bermed Bunker Area Soil Boring, Test Pit, and PCB Field Screening Sample Locations. ....	2-52
Figure 2-9. Small Foundation Area and Bermed Bunker Area Cross-Section B-B' and Analytical Results. ....	2-58
Figure 2-10. Former Underground Bunker Area Construction Details and Sample Locations. ....	2-66
Figure 2-11. Docking Area and Lookout Pad Soil Boring and Test Pit Sample Locations. ....	2-69
Figure 2-12. Docking Area and Lookout Pad PCB Field Screening Sample Locations and Results. ....	2-71
Figure 2-13. Lookout Pad Oblique Block Diagram and Analytical Results. ....	2-78
Figure 2-14. Ravine Area Test Pit Sample Locations. ....	2-82
Figure 2-15. Conceptual Site Model. ....	2-88

## LIST OF ACRONYMS AND ABBREVIATIONS

AAA	Anti-Aircraft Artillery
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AMSL	Above mean sea level
AOC	Area of concern
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
ATH	Ambient temperature headspace
AUE	Area Under Evaluation
BBA	Bermed bunker area
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and total xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	Chemical of potential concern
COPEC	Contaminant of potential ecological concern
CSM	Conceptual site model
CSRP	Contaminated Sites Remediation Program
cy	Cubic yard
DAR	Data assessment report
DBA	Drum Bunker Area
DKA	Docking area
DRMO	Defense Reutilization and Marketing Office
DRO	Diesel range organics
EAFB	Elmendorf Air Force Base
EE/CA	Engineering Evaluation/Cost Analysis
EM	Electromagnetics
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ESF	Environmental Staging Facility
ft <sup>2</sup>	Square feet

**LIST OF ACRONYMS AND ABBREVIATIONS (Continued)**

GPR	Ground-penetrating radar
GRO	Gasoline range organics
HBL	Health-based limits
HDPE	High-density polyethylene
HHS	Heated headspace
HI	Hazard index
HQ	Hazard quotients
IDW	Investigation-derived waste
IRP	Installation Restoration Program
LFA	Large foundation area
LFI	Limited Field Investigation
LND	Suspected Landfill Area
LOP	Lookout Pad
µg/kg	Micrograms per kilogram
mg/kg	Milligrams per kilogram
MPA	Motor Pool Area
MCL	Maximum contaminant level
MCLG	Maximum contaminant level goal
mL	milliliters
ML	Method quantitation limits
MS/MSD	Matrix spike/matrix spike duplicate
NFRAP	No Further Response Action Planned
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PID	Photoionization detector
POI	Point of interest
POL	Petroleum, oil, and lubricants
PPE	Personal protective equipment
ppm	Parts per million
PVC	Polyvinyl chloride
QA	Quality assurance

**ACRONYMS AND ABBREVIATIONS (Continued)**

QA/QC	Quality assurance/quality control
QC	Quality control
RBC	Risk-based concentrations
RCRA	Resource Conservation and Recovery Act
RNA	Remediation by natural attenuation
RRO	Residual range organics
RVA	Ravine area
SFA	Small foundation area
SVOC	Semi-volatile organic compound
TOC	Total organic carbon
UBA	Underground bunker area
USAED-AK	U.S. Army Engineer District-Alaska
USAF	U.S. Air Force
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
UST	Underground storage tank
UTL	Upper tolerance limit
UXO	Unexploded ordnance
VOC	Volatile organic compound



## EXECUTIVE SUMMARY

The SS83 Engineering Evaluation/Cost Analysis (EE/CA) addresses contamination within the approximately 20-acre SS83 site located on Elmendorf Air Force Base (EAFB), Alaska. The purpose of this EE/CA is to evaluate alternatives for selection of an appropriate removal action to address hazardous substances identified at various areas of investigation located within the main portion of the SS83 site. This EE/CA has been prepared in accordance with the National Contingency Plan and U.S. Environmental Protection Agency (EPA) EE/CA guidance (EPA 1993). The SS83 site is not being addressed under any other remedial investigation/feasibility study and/or response action.

EAFB is located in Southcentral Alaska, along the head of Cook Inlet and adjacent to the City of Anchorage. Approximately half of the Base is developed for airfield and support operations while the remaining portion is mostly undeveloped boreal forest. The SS83 site is located in the northwestern portion of the Base in a generally undeveloped area near the shoreline of Cook Inlet.

Historical records indicate that multiple activities have occurred at the site since acquisition by the U.S. Army and then by the U.S. Air Force. The predominant activity was as an Anti-Aircraft Artillery (AAA) battery. The U.S. Army, responsible for ground and antiaircraft defense in Alaska, would have operated the AAA site. The U.S. Air Force decommissioned the AAA site in the 1960s soon after they acquired the area.

In 1996, the SS83 site was incorporated into basewide environmental evaluation processes undertaken by EAFB as part of restoration activities conducted under the U.S. Air Force's Installation Restoration Program. The site was designated an area of concern because preliminary investigations indicated possible risks to human or ecological receptors. EAFB conducted limited field investigations at the site in 1997 and 1998 at several areas of possible contamination. Evidence of historical hazardous substance releases was identified at several areas, and additional investigation was recommended.

In 2000, EAFB initiated the current EE/CA investigation. The goal was to characterize site contamination and assess site risks in order to evaluate possible removal actions. The site characterization included in this EE/CA is based on previous investigation results and the results of site visual inspections, geophysical surveys, and environmental sampling and analyses conducted as part of the 2000 SS83 EE/CA field investigation.

The SS83 EE/CA field investigation was conducted in the summer of 2000. The EE/CA focused on ten areas of investigation where hazardous substance releases were possible:

- |                                      |                                      |
|--------------------------------------|--------------------------------------|
| 1) the drum bunker area (DBA)        | 6) the bermed bunker area (BBA)      |
| 2) the large foundation area (LFA)   | 7) the underground bunker area (UBA) |
| 3) the motor pool area (MPA)         | 8) the ravine area (RVA)             |
| 4) the suspected landfill area (LND) | 9) the docking area (DKA)            |
| 5) the small foundation area (SFA)   | 10) the lookout pad area (LOP)       |

A streamlined risk evaluation assessed the cumulative site risks associated with continued industrial use of the site under a no further action scenario. The streamlined risk evaluation determined that ADEC soil, groundwater cleanup levels are protective of anticipated human exposures under the residential scenario, and that cumulative site risks due to petroleum hydrocarbons are below risk management thresholds applicable to the site. Metals in groundwater located near the SFA do exceed hazard thresholds, although the shallow aquifer at SS83 is not currently a source of drinking water. Estimating risk assuming residential exposures is also protective of exposures anticipated under the military/industrial scenario expected for the SS83 site. Although no adverse cumulative site risk was identified assuming no further action, contaminated soils with known concentrations of petroleum hydrocarbons above applicable cleanup levels remain at several areas within the SS83 site.

To address ecological risk concerns, a brief risk-based screening for contaminants of potential ecological concern (COPEC) consistent with EPA guidance documents was performed. The goal of the screening approach was to evaluate potential adverse effects to the terrestrial ecosystem associated with soil contamination at the SS83 site. Risk-based screening indicated that petroleum hydrocarbons and select polycyclic aromatic hydrocarbons (PAHs) detected in surface soils at the SS83 site might represent possible ecological risks. However, these potential risks are likely to be low and mitigated upon completion of the expected removal activities.

Based on the results of site characterization and the development of removal action objectives, a limited number of removal action alternatives were identified for consideration within this EE/CA. The response action alternatives considered are as follows:

- No Further Action (Alternative 1)
- Institutional Controls (Alternative 2)
- Removal with Disposal (Alternative 3)
- Treatment (Alternative 4)

In accordance with the EE/CA guidance, all of the removal action alternatives were evaluated and screened with respect to implementability, effectiveness, and cost. All of the potential removal actions passed the initial screening and were retained for further evaluation of their

applicability, either individually or in combination, to the specific settings and conditions found within the SS83 site.

The findings of the detailed analysis are generally as follows:

- Alternative 1 is effective and warranted for only two specific areas of investigation: the UBA and the RVA.
- Alternative 2, if properly established and enforced, can easily reduce the duration and frequency of human exposures to hazardous substances. At certain areas of investigation within the SS83 site, institutional controls may be effective as stand-alone actions; for example, using fencing and signs to restrict access to small areas of particular concern. Controls restricting site access are currently in place at the site and are expected to continue.
- Selective removal with disposal of contaminated material (Alternative 3) is effective, feasible, and cost-effective for specific areas of investigation within the SS83 site where contaminants are present at concentrations that may pose a risk to human or ecological receptors or are above cleanup levels.
- Treatment, using remediation by natural attenuation or intrinsic bioremediation, without excavation (Alternative 4), would be effective in reducing site contaminants to acceptable levels after a long period.

In addition to the individual evaluations, a comparative analysis of the alternatives was also made. The comparative analysis built upon the detailed analyses by examining the relative performance of each alternative within the context of the evaluation criteria (implementability, effectiveness, and cost). The findings of the comparative analysis are as follows:

- The relative effectiveness of each alternative depends upon matching one or more of the alternatives to the particular area of investigation characterized at the SS83 site. Alternative 2 is generally limited in effectiveness when implemented without other direct actions; however, institutional controls may be very useful in combination with the effectiveness of Alternatives 3 or 4. Alternative 3 is more effective in the short-term than Alternative 4.
- Each of the four alternatives is feasible at the SS83 site. The practicality of physical removal of contaminated materials (Alternative 3) varies at some areas of investigation. For example, the removal of contaminated soils from along the bluff and at areas adjacent to the bluff (e.g., the LOP or the LND) may be more difficult than Alternative 4.
- The relative costs of Alternative 3 compared to Alternative 4 will vary. The actual costs for Alternative 3 are dependent on the vertical and lateral extent of removal,

while costs for Alternative 4 are dependent on the need for modeling or ongoing monitoring. The cost of Alternative 3, as anticipated based on the current site characterization, is considered less than for Alternative 4.

The selection of specific removal actions for each area of investigation considered the location of the SS83 site, the nature and extent of contamination at each area, the cumulative human health site risk, and the anticipated future use of the site. Although this EE/CA has not made a detailed evaluation of ecological risks, the recommended removal actions are expected to be beneficial in mitigating risks to potential sensitive ecological receptors.

The following recommended removal actions are cost-effective, will mitigate the identified human health concerns, satisfy applicable cleanup regulations, and accommodate future land uses:

- No further action is recommended for the UBA, RVA, or DKA.
- Selective removal with disposal of surface and shallow subsurface soils is recommended for the BBA, SFA, LFA, DBA, and LOP. Removal of impacted soil at SFA will also presumably remove a source of groundwater contamination. Removal of potentially contaminated soil is also recommended for the MPA.
- Additional investigation of the LND is recommended to further characterize the nature and extent of possible contamination due to the suspected landfill.

## **1.0 INTRODUCTION**

### **1.1 EE/CA Report Objectives**

This Engineering Evaluation/Cost Analysis (EE/CA) addresses proposed removal action alternatives for the SS83 site at Elmendorf Air Force Base (EAFB), Alaska. Several potential contaminant source areas within the SS83 site have been investigated to determine the need for removal action. This EE/CA report presents the SS83 site description and background and describes the site characterization that has been conducted to support development of removal action alternatives as needed.

The objectives of this EE/CA report are to identify removal action objectives for the SS83 site, to identify and evaluate removal action alternatives that may achieve those objectives, and to recommend the alternative that best meets the removal action objectives. The purpose of an EE/CA is also to balance cost with technical concerns for each removal alternative under consideration.

A field investigation was conducted at SS83 during the summer of 2000 to collect data for determining the existence of a release or the threat of a release at the site. Based on the findings of previous site investigations and the 2000 field investigation, an evaluation of the risk posed by SS83 supports the need for a non-time-critical removal action. Therefore, this EE/CA presents removal action objectives and proposes removal action alternatives to minimize or eliminate the risk posed by a release or threat of release from multiple sources within the SS83 site. The 10 specific areas to be addressed in this EE/CA report are 1) the large foundation area, 2) the motor pool area, 3) the bermed bunker area, 4) the small foundation area, 5) the underground bunker area, 6) the ravine area, 7) the docking area, 8) the lookout pad area, 9) the drum bunker area, and 10) the suspected landfill area.

### **1.2 Cleanup Criteria**

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program as implemented by the EAFB Environmental Restoration Program offers an option for petroleum, oil, and lubricant (POL) contaminated sites such that appropriate State cleanup criteria, including specific cleanup levels, become the regulatory driver for a site (USAF 1996). Based on the results of the field investigation conducted in 2000, the SS83 site is considered a POL site (refer to Section 2.0 of this report). The Alaska Department of Environmental Conservation (ADEC) provides soil and groundwater cleanup levels and risk management criteria for POL sites under Methods Two and Three of the Contaminated Sites Remediation Program (CSRP; 18 AAC 75). As documented in the SS83 EE/CA Work Plan (USAF 2000a) as well as the EE/CA Approval Memorandum (USAF 2000b), the planning and scoping process for the SS83 EE/CA identified that the ADEC risk-based soil and groundwater cleanup levels would be the management standards for the site.

When a non-time-critical removal action will be the only or last action to be taken to clean up a site, the EE/CA should provide adequate documentation that activities performed at the site are sufficient to meet completion requirements. This EE/CA identifies, evaluates, and recommends removal action alternatives that could be implemented as the final clean up action at the site, but additional future actions are also anticipated for certain areas of the site, particularly, the suspected landfill area. In order to identify the scope of any potential removal actions and to document that any recommended actions are sufficient to meet State closure requirements for POL sites, a streamlined risk evaluation is required. For this EE/CA, the streamlined risk evaluation focuses on the specific concerns at the SS83 site and ensures that the non-time-critical removal action will meet the cleanup criteria established by the State of Alaska for POL-contaminated sites.

An EE/CA must be completed for all non-time-critical removal actions under CERCLA, as required by section 300.415(b)(4)(i) of the National Contingency Plan, Title 40 of the Code of Federal Regulations, Part 300.

Under CERCLA, a non-time-critical removal action is conducted at sites where a threat to public health or welfare or the environment exists. The removal action is taken to abate, prevent, minimize, stabilize, mitigate, or eliminate a release or threat of release posed at a site, and may constitute an interim or a final action. For the SS83 site, the EE/CA process offers a mechanism for accomplishing a more timely reduction of the risk posed by the site.

### **1.3 EE/CA Report Organization**

This EE/CA report is divided into the following sections:

- Section 1.0 serves to introduce the EE/CA Report and its objectives, outlines the regional setting, and describes the SS83 site, including its history and previous environmental investigations.
- Section 2.0 describes the site characterization conducted at SS83 during 2000, including details on all field investigation activities and sample results, an interpretation of the nature and extent of contamination, and the risk posed by the site.
- Section 3.0 outlines objectives of removal action(s) necessary to address the risk posed by the site.
- Section 4.0 identifies and evaluates removal action alternatives that will fulfill the removal action objectives outlined in Section 3.0. Alternatives are evaluated against criteria including effectiveness, implementability, and cost.
- Section 5.0 presents a comparison of the removal action alternatives identified in Section 4.0.

- In Section 6.0, the preferred removal action alternative(s) is recommended, with rationale for that alternative's selection presented.
- Section 7.0 lists the references cited in the EE/CA Report.

Appendices to the EE/CA report include documentation from the field investigation, such as boring logs, well construction diagrams, test pit logs, field screening results, the geophysical survey report, investigation-derived waste (IDW) management documentation, and site photographs. In addition, the data assessment report (DAR) is included as an appendix to this report.

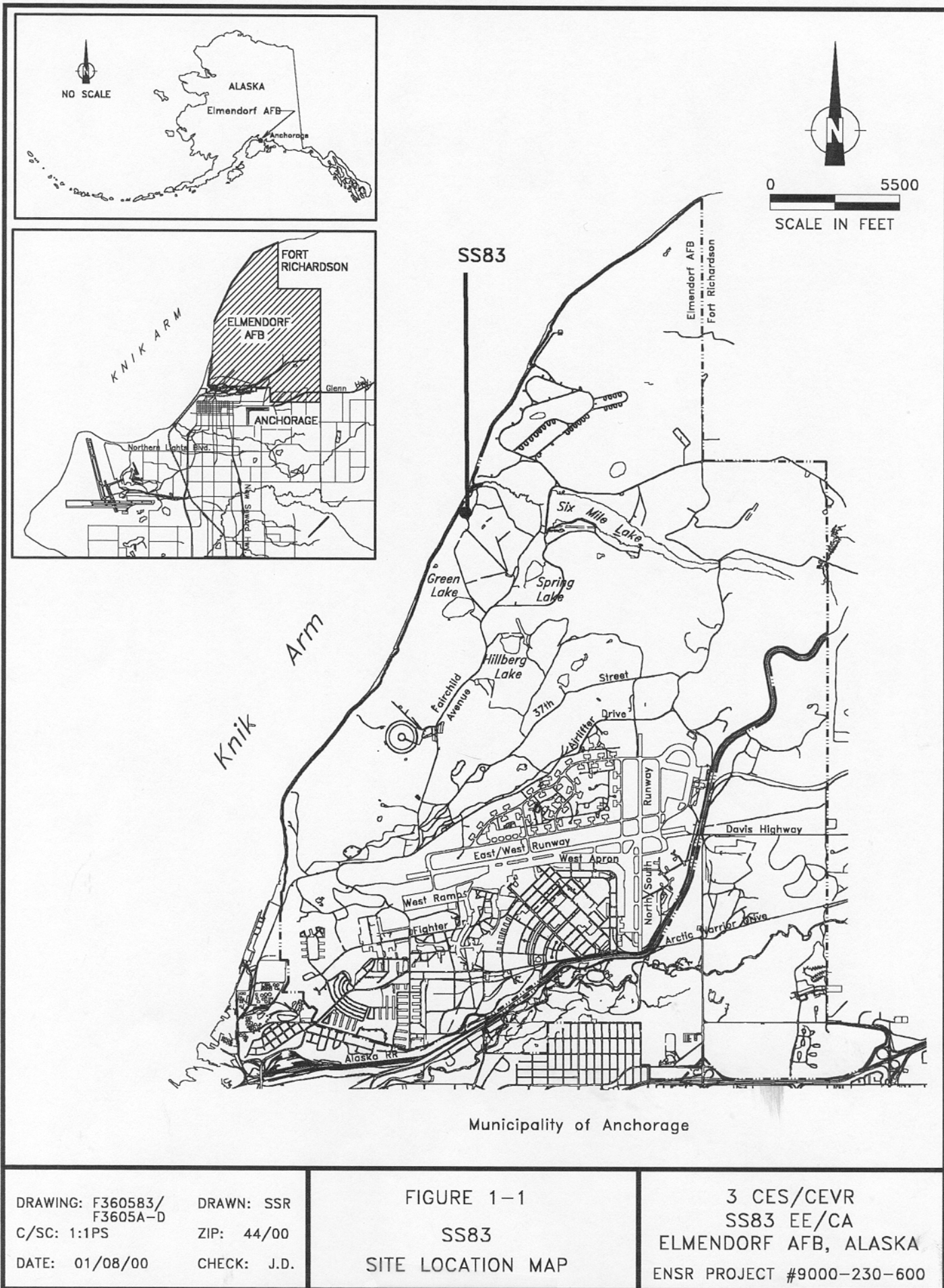
## **1.4 Regional Setting**

EAFB is located in Southcentral Alaska, along the head of Cook Inlet and adjacent to the City of Anchorage (Figure 1-1). EAFB comprises 13,130 acres, bordered to the north and west by Cook Inlet, to the east by Fort Richardson, and to the south by the City of Anchorage. Land use at EAFB is varied. Nearly half (6,053 acres) of the Base has been developed for airfield operations (runways, taxiways, and maintenance areas) and support operations, including housing and recreational facilities. The remaining acreage (7,077 acres) is mostly undeveloped and includes 1,416 acres of wetlands, lakes, and ponds.

EAFB lies within the Cook Inlet-Susitna Lowlands, which is bordered on the west by the Alaska Range and on the east by the Kenai, Chugach, and Talkeetna mountain ranges. The Elmendorf terminal moraine traverses the Base northeast to southwest. The southern boundary of the Elmendorf Moraine is a ridgeline running along the north side of the east-west runway.

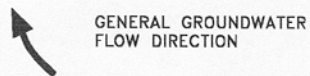
At the Elmendorf Moraine, a groundwater divide closely matches the moraine crest. The Elmendorf Moraine divides groundwater flow. Regional groundwater flow south of the moraine is south and west toward Ship Creek. Regional groundwater flows to the west-northwest on the northern limb of the moraine and to the west on the western side. Figure 1-2 shows the regional groundwater flow on EAFB. The general groundwater flow direction at the SS83 site, along the bluff and adjacent to the beach, is west toward Knik Arm (USAF 1999a).

In the northwestern portion of EAFB, morainal sediments outcrop along a steep escarpment (bluff) overlooking Knik Arm. This escarpment was caused by the rebound of the ground surface after glacial retreat and erosion of the moraine from glacial meltwater. At the base of the escarpment, a sandy beach horizon has developed. The beach horizon is composed primarily of well-sorted littoral sands, as the tidal range of the Knik Arm periodically covers the entire beach. The beach horizon overlies clay lenses of the Bootlegger Cove formation, which outcrop intermittently along the beach. The shallow groundwater at the beach appears to be laterally consistent with the groundwater in the western portion of the outwash plain.

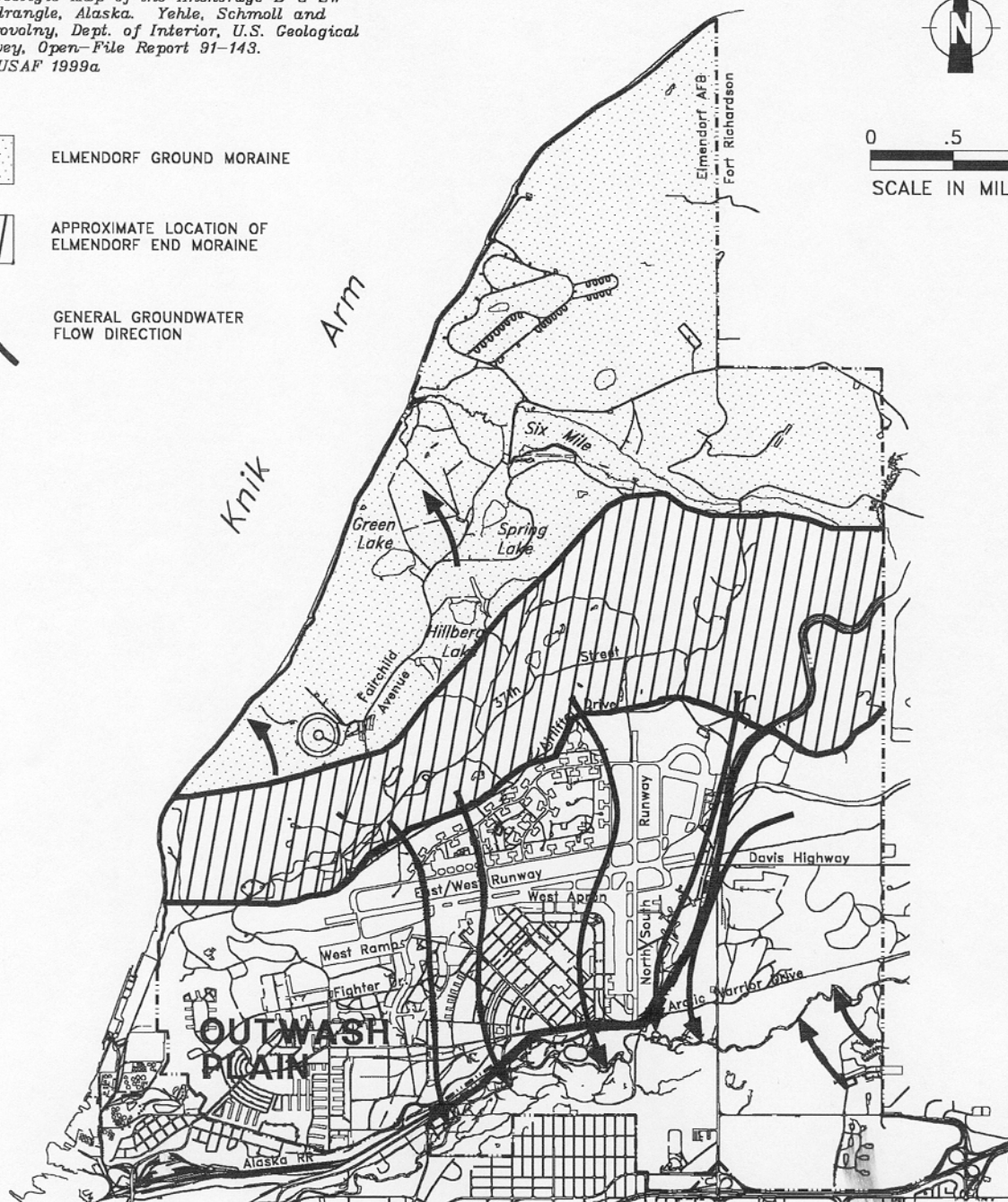




- 1.) CRREL 1997 Interim Draft. *The Glacial Geology and Stratigraphy of Fort Richardson: A Synthesis of The Hydrogeologic Framework.*
- 2.) Operable Unit 5, Groundwater Modelling Report, December, 1994.
- 3.) *Geologic Map of the Anchorage B-8 SW Quadrangle, Alaska.* Yehle, Schmoll and Dobrovolsky, Dept. of Interior, U.S. Geological Survey, Open-File Report 91-143.
- 4.) USAF 1999a.



0 .5 1  
SCALE IN MILES



Municipality of Anchorage

DATE: 01/17/01

CHECK: J.D.

FIGURE 1-2  
REGIONAL GROUNDWATER  
FLOW PATTERNS

3 CES/CEVR  
SS83 EE/CA  
ELMENDORF AFB, ALASKA  
ENSR PROJECT #9000-230

## 1.5 Site Description and Background

This section provides a general site description and background information for the 10 investigation areas at the SS83 site. Information was obtained from aerial photographs, site drawings, previous investigations reports, and correspondence with EAFB. Based on a review of basewide environmental restoration and other environmental compliance programs, the site is not considered associated with any other environmental investigation (USAF 1997).

### 1.5.1 Site Location

The SS83 site is located in the northwestern portion of the base, between Six Mile Lake and Knik Arm on the north side of the Elmendorf Moraine (Figure 1-1). The site is located in an area that is currently used as the Rosette Antenna Site operated by the EAFB 3<sup>rd</sup> Communications Squadron. Except for site workers, security forces, and other authorized personnel, access to the site is restricted. As shown in Figure 1-3, gates were installed during 2000 at two access points to prevent vehicular access to the area.

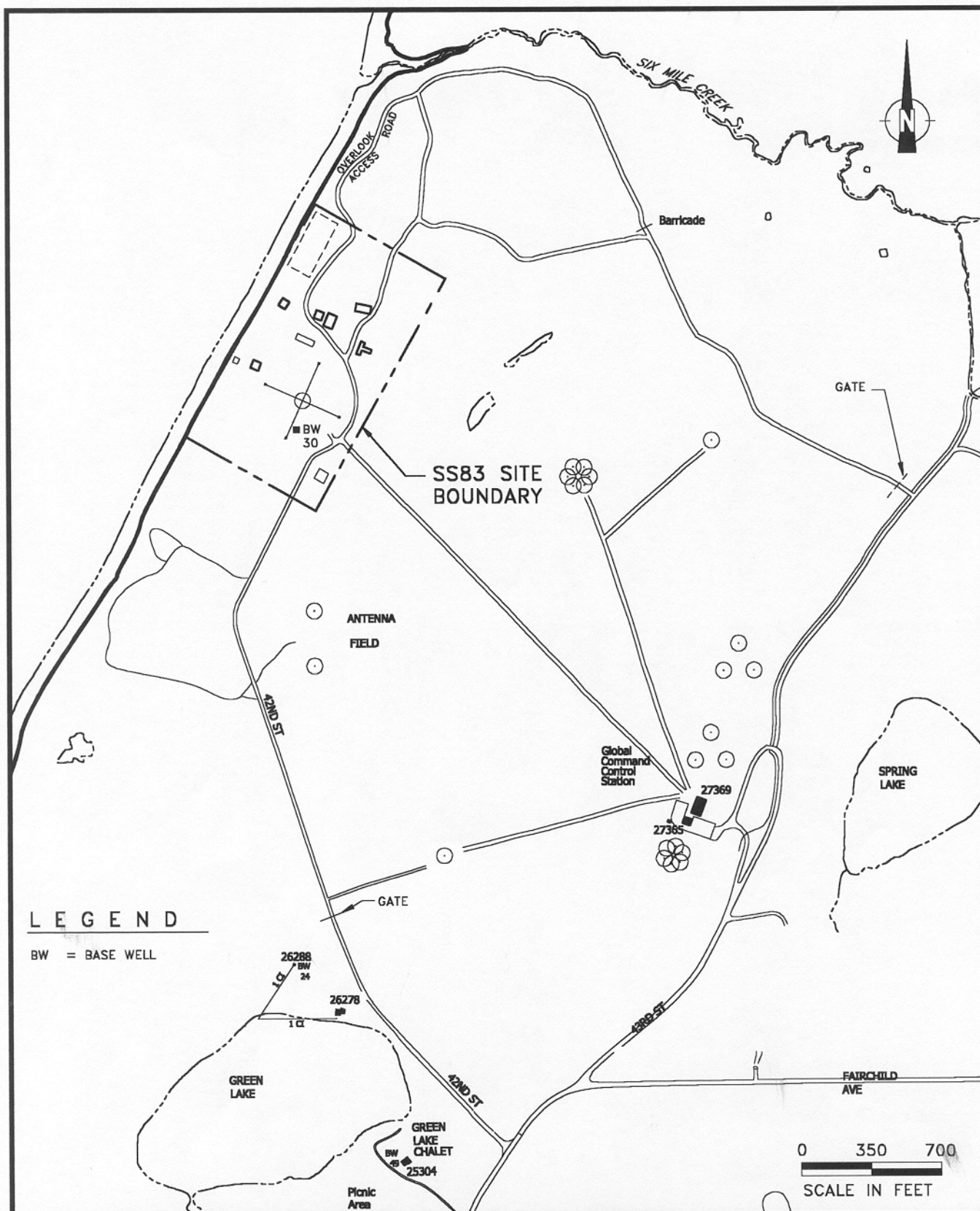
Figure 1-3 also shows the site in relation to nearby features. The SS83 site originally encompassed approximately 20 acres. Based on the results of initial site inspections (e.g., site walk and surveys), approximately 5 acres of the site was targeted for site characterization.

### 1.5.2 Site History and Use

Records from 1949 indicate five small buildings (log structures) were located at the site that was then called Search Light Area No. 4. Base plans from 1951 revealed 24 buildings existing at this site designated as "Alaska Scouts Combat Intelligence" and labeled as "Battery D 96th Anti-Aircraft Artillery (AAA)." The AAA battery would have been operated by the U.S. Army, responsible for ground and anti-aircraft defense in Alaska (USARAL 1972). Other activities may also have occurred at the site. This area is currently the active Rosette Antenna Site operated by the 3rd Communications Squadron.

Historical information suggests that AAA batteries and garrisons were constructed according to standardized designs. The AAA battery would have included 12 Quonset huts for a garrison and a battery headquarters building (two joined Quonset huts). The Quonset huts were lined up in an orderly fashion, creating a small camp. Usually, a short distance away was a splinter-proof radar shelter constructed of 55-gallon drums filled with soil. Also nearby were revetments for the 90-mm and later, 120-mm guns. Between the radar and gun emplacements was a semi-underground ordnance shop. Two ammunition magazines and a fuse storage shelter completed the facility (USAED-AK 1994).

The Alaska AAA batteries were divided between the Fort Richardson and Ladd Air Force Base (Fort Wainwright) areas. Although some of their locations are unknown, very few AAA batteries have survived. The SS83 site was decommissioned by EAFB in the 1960s.



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 C/SC: 1:1PS      ZIP: 44/00  
 DATE: 01/17/01      CHECK: J.D.

FIGURE 1-3  
 SS83 SITE BOUNDARY

3 CES/CEVR  
 SS83 EE/CA  
 ELMENDORF AFB, ALASKA  
 ENSR PROJECT #9000-230

### **1.5.3 Site Features and Structures**

As shown in Figure 1-4, several original structures are currently in existence at the SS83 site, many of which are associated with the EE/CA areas of investigation. Most of these structures (concrete foundations, underground storage tanks [USTs], soil berms, underground bunkers, drum walls, and demolished structures) are associated with former uses of the site. For example, a large network of buried electrical and communication lines exist throughout the main portion of the SS83 site. The conduits are believed to be associated with the former AAA site. The only active structures at the site are connected with the Rosette Antenna and its associated cable route.

An inactive water well (BW-30) is reportedly located south of the Rosette Antenna. However, evidence of the well was not observed during the 2000 field investigation, as the likely location of BW-30 is within the perimeter of the Rosette Antenna and could not be accessed. BW-30, also referred to as the "Fish Camp Well," was drilled in 1946 to a depth of 261 feet. Water sample analytical reports suggest that the well was active until at least 1957.

The following subsections provide preliminary site descriptions for the 10 investigation areas. Provided in Section 2.4 are detailed observations and site inspections results for each area. No archaeologically significant features were identified during the 2000 field investigation.

#### **1.5.3.1 Drum Bunker Area**

The drum bunker area (DBA) is located within the southeastern portion of the site on top of a small hill. This "U" shaped structure consists primarily of soil berms and soil-filled drum walls, and was likely a gun emplacement. This area of investigation was added during the 2000 field investigation and is further described in Section 2.2.

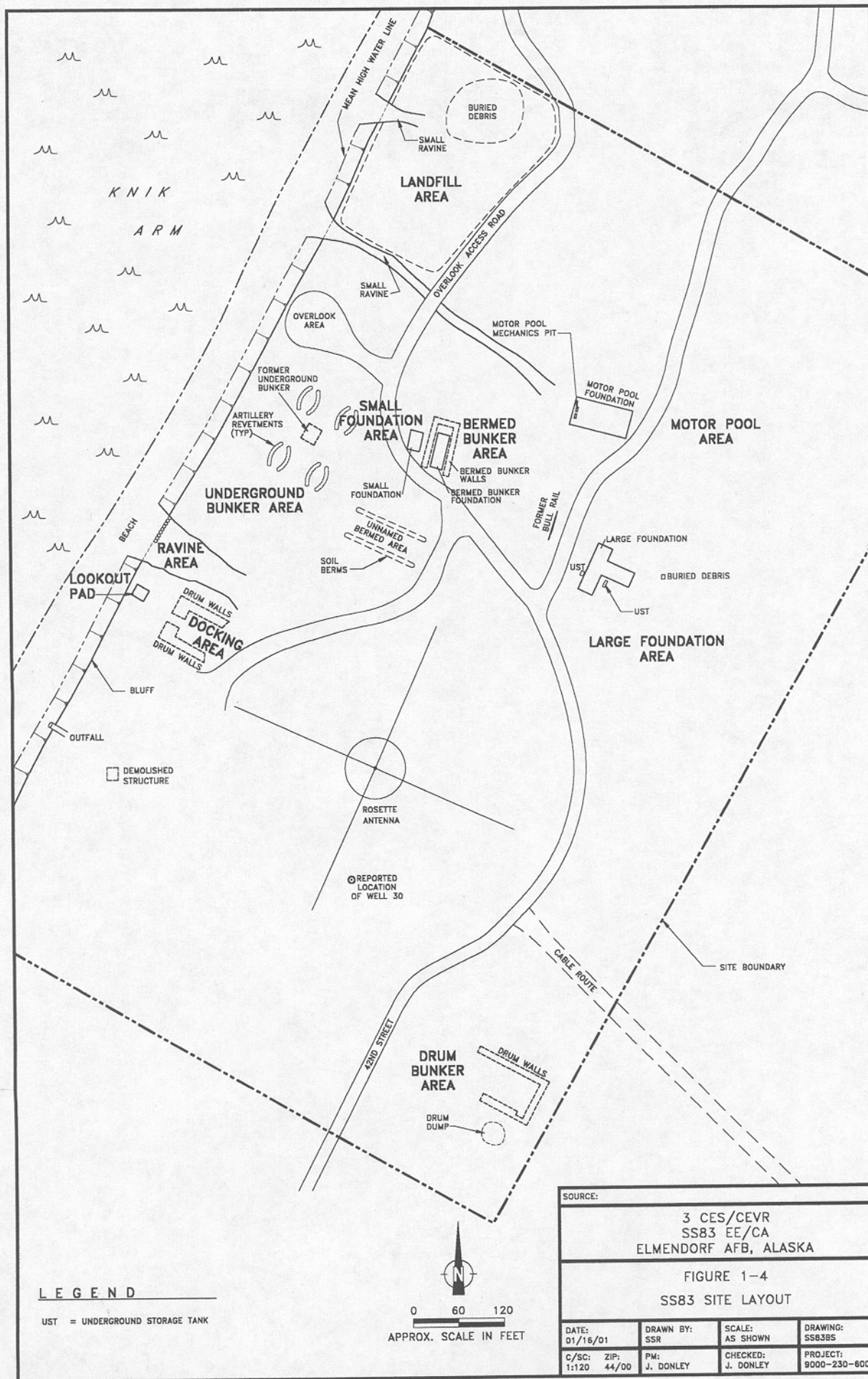
#### **1.5.3.2 Large Foundation Area**

The large foundation area (LFA) is located to the east of 42<sup>nd</sup> Street (formerly Mountain Road) at the eastern extent of the SS83 site. The area consists of a concrete pad approximately 2,000 square feet (ft<sup>2</sup>) in area. This is the site of a former building suspected to have housed several transformers and a transformer maintenance area (USAF 1999b). Based on other AAA site designs, this building more likely served as the AAA Battery Headquarters building.

#### **1.5.3.3 Motor Pool Area**

The motor pool area (MPA) is located north of the large foundation on the west side of Mountain Road. This area consists of a concrete pad approximately 1,700 ft<sup>2</sup> in area with a pit located in the west end of the pad. The pit is approximately 4 feet wide and 12 feet long and contained soil mixed with old and new oil filters, rags, roots, and other debris.





SOURCE:			
3 CES/CEVR SS83 EE/CA ELMENDORF AFB, ALASKA			
FIGURE 1-4 SS83 SITE LAYOUT			
DATE: 01/16/01	DRAWN BY: SSR	SCALE: AS SHOWN	DRAWING: SS83B5
C/SC: 1:120	ZIP: 44/00	PM: J. DONLEY	CHECKED: J. DONLEY
		PROJECT: 9000-230-600	

#### **1.5.3.4 Suspected Landfill Area**

The suspected landfill area (LND) is located within the northwestern portion of the site. This feature is characterized by areas of surface debris and man-made surface topography. This area of investigation was added during the 2000 field investigation and is further described in Section 2.2.

#### **1.5.3.5 Small Foundation Area**

The small foundation area (SFA) is located to the west of the bermed bunker area and consists of a concrete pad approximately 400 ft<sup>2</sup> in area. This location was thought to be a former generator or transformer pad.

#### **1.5.3.6 Bermed Bunker Area**

The bermed bunker area (BBA) consists of a 400 ft<sup>2</sup> concrete pad originally surrounded on three sides by stacked, soil-filled drums. This area is located between the motor pool and the small foundation north of the overlook area access road. The drums apparently were used as a splinter-proof retaining wall. A 6-foot-high soil berm forms the outside of the drum wall. The purpose of the bermed bunker area is not known. Possible former uses for this area include POL storage, ordnance shop, generator power plant, transformer maintenance, and/or other storage/maintenance activities. The origin of the 55-gallon drums as well as the origin of materials used to fill the 55-gallon drums is not known.

#### **1.5.3.7 Underground Bunker Area**

The underground bunker area (UBA) contained an underground bunker located between former AAA gun revetments. The bunker was approximately 5 feet high inside with a reinforced concrete roof and timber supports. The UBA covered an area of approximately 200 ft<sup>2</sup>. This area is west of the BBA and the SFA. The floor of the bunker contained soil, wooden and other debris, overlying a concrete pad. Based on historical documents regarding AAA Battery designs, the underground bunker may have been used as a semi-underground ordnance shop. Contaminants associated with these activities included petroleum-based products, paints, and waste oil.

The UBA was surrounded by four revetments. These former gun emplacements were constructed with sandbags and soil-filled drums. Three of the four gun revetments contained a collapsed ammunition magazine and/or fuse storage shelter.

#### **1.5.3.8 Ravine Area**

The ravine area (RVA) is approximately 100 feet long and 30 feet wide and opens out to Knik Arm. The ravine appears to be man-made and not due to natural erosion. Soil-filled drums were evident along the sidewalls of the ravine. At the base of the ravine, there is a 10-foot-high

retaining wall constructed of perforated steel, timbers, and empty 55-gallon drums. The drums appear to serve no function other than as a retaining wall. Several drums have fallen toward the shoreline due to collapse of the wall. There was an 8-inch wood-stave pipe protruding from the south sidewall of the ravine approximately 8 feet from the floor of the ravine and 6 feet from the crest. Also located within the ravine are several concrete supports.

#### **1.5.3.9 Docking Area**

The docking area (DKA) is located west of the Rosette Antenna and consists of a 15-foot-high three-walled area. The walls are formed with stacked, soil-filled drums covered by soil. This structure has a walkway exiting the west wall and facing Knik Arm. Within this enclosure is a collapsed wooden structure with corner support beams and standing approximately 3 feet high. This area has been identified as a docking area because of the presence of a concrete pad that appears to have been used specifically for vehicle parking based on its size and shape, as well as the ramp present at the entrance. The remains, however, appear to be similar to radar shacks used to house U.S. Army radars and associated equipment (USAF 1999b).

#### **1.5.3.10 Lookout Pad Area**

The lookout pad area (LOP) is located along the bluff approximately 50 feet west of the DKA. A 17-by-18-foot concrete pad is present at this location. This area of investigation was added during the 2000 field investigation and is further described in Section 2.2.

### **1.5.4 Topography**

As shown in Figure 1-2, the topography of EAFB can be separated into three broad subdivisions that resulted from the Naptowne Glaciation:

- the ridges running northeast to southwest that form the terminal (end) moraine called the Elmendorf Moraine;
- a broad surface of sand and gravel called the Outwash Plain that is parallel to and south of the Elmendorf Moraine;
- smooth-surfaced elongate hills, linear valleys, and small lakes that characterize the pitted surface on the ground moraine north of the Elmendorf Moraine.

The SS83 site is located within the ground moraine. The ground moraine is an area of relative low relief that seldom exceeds 50 to 75 feet in elevation. Several SS83 site features have been surveyed, and the elevation of the site is on average 51 to 63 feet above mean sea level (AMSL) and gradually increases in elevation to the east. Two east-to-west trending depressions are present along the bluff (Ravine Area and Landfill Area). It is unknown whether these depressions are the result of erosion or are man-made. Neither depression had surface water runoff observed during the EE/CA field investigation. The west side of the SS83 site is located

25 to 35 feet AMSL along the bluff of Knik Arm. The slope of the bluff ranges from approximately 25 degrees at the base above the beach interface to vertical near the top edge of the bluff.

A bluff erosion rate has been estimated using aerial photographs and the relative position of fixed site features (i.e., gun revetments) to the bluff in different years. Revetments that were approximately 30 to 40 feet from the bluff in 1962 are currently approximately 1 to 2 feet from the bluff. This translates to an average bluff erosion rate of approximately 1 foot per year over the last 38 years. Further, based upon observations made during the 2000 SS83 field investigation and discussions with engineers familiar with the Knik Arm bluff, a bluff regression of 2 feet per year is estimated.

### **1.5.5 Site Geology**

#### **1.5.5.1 Stratigraphy**

Surficial soils in the vicinity of the SS83 site are mapped as Typic Cryorthods and Sphaginic Borofibrists (USDA 1979). Typic Cryorthod soils are composed of silty loam and are well drained. Typic Cryorthods have moderate accumulations of organic carbon, aluminum, and iron in the spodic horizon and have no permafrost. These soils generally have a thin albic horizon below the organic mat and a dark reddish brown to dark yellowish brown spodic horizon. The bottom of the spodic horizon is seldom more than 20 inches deep (USDA 1979). The relative permeability of the surficial soil west of 42<sup>nd</sup> Street to the bluff are mapped as having high to very high relative permeability (USGS 1976). The surficial soils east of 42<sup>nd</sup> Street in the vicinity of the site are mapped as having moderate to high relative permeability (USGS 1976). Sphaginic Borofabrists are poorly drained soils that consist of coarse, fibrous peat in depressions and shallow basins. Peat is present at the surface south of the LOP and DKA in a level, wet area.

The sediments in the vicinity of the site have been mapped as Pre-Wisconsin-aged Bootlegger Cove clay (Knik Glaciation) and Wisconsin-aged advance outwash and ground moraine deposits of the Naptowne Glaciation (USGS 1959, 1964). The advance outwash deposit is stratigraphically the lowest Naptowne glacial deposit and overlies the Bootlegger Cove clay of the Knik glaciation (USGS 1959). The second oldest Naptowne deposit is the end moraine deposit (Elmendorf Moraine) extending northeastward through EAFB. The end moraine grades into the ground moraine that covers most of the area north of the end moraine (USGS 1959). The advance outwash is interpreted as being deposited in front of an actively moving glacier. Thus, the advance outwash was deposited by melt-water streams flowing in front of the Wisconsin glacier as it advanced to the position marked by the end moraine. The outwash was deposited over the Bootlegger Cove clay and in turn was covered by the ground moraine deposited by the overriding glacier (USGS 1959).

Naptowne advance outwash deposits consist of stratified sand and pebble and cobble gravel that overlies the Bootlegger Cove clay and underlies the ground moraine along Knik Arm. The



advance outwash is exposed almost continuously northeastward from Cairn Point (located 2.5 miles southwest of SS83) in the bluff along the east shore of Knik Arm, where it overlies the Bootlegger Cove clay, to at least Eagle River (located 4 miles northeast of SS83). The exposed thickness of the Naptowne advance outwash ranges from 5 feet to 42 feet along Knik Arm. Near the mouth of Sixmile Creek (1/4 to 1/2 mile northeast of SS83), the lower part of the advance outwash directly overlies the Bootlegger Cove clay and is cemented by iron oxide into massive layers of hard, compacted conglomerate that extends for about 1 mile south of the creek (USGS 1959). The iron oxide cemented conglomerate blocks were observed along the beach beneath the bluff approximately 200 feet south of the LOP. No iron oxide cemented conglomerate blocks were observed immediately beneath the SS83 EE/CA investigative area. Seeps and springs along the upper surface of the Bootlegger Cove clay deposited iron oxides to cement the conglomerate (USGS 1959). Groundwater seeps are more prevalent 200 feet south of the LOP; however, seeps were observed at the LOP and along the bluff west of the LND.

The ground moraine is composed predominantly of tan to light-gray compact, stony till that contains rounded cobbles in a silt and clay matrix (USGS 1959). The exposed thickness of the ground moraine ranges from about 6 feet to 40 feet along Knik Arm and the Eagle River. Two contacts have been mapped between the ground moraine and underlying advance deposits. Some ground moraine deposits exposed between Eagle River and Sixmile Creek exhibit a well-defined, distinct contact between the Naptowne till and the underlying stratified sand and gravel of the advance outwash, and in other exposures it is obscure and appears to be gradational (USGS 1959). Naptowne till is discontinuous along the bluff of Knik Arm. Stratified sand and gravel, which extends to the top of the bluff, locally overlies the Bootlegger Cove clay. This relationship is true in the location of SS83 LOP (NE1/4 SE1/4 sec. 20, T. 14 N, R. 3 W), where the Bootlegger Cove clay is overlain by about 40 feet of sand and gravel (USGS 1959). Some of this stratified sand and gravel is advance outwash deposited in front of the advancing Wisconsin Glacier (USGS 1959). Boring logs and test pit logs from the SS83 EE/CA field investigation confirm the presence of stratified sand and gravel advance outwash deposits directly overlying the Bootlegger Cove clay (refer to Figure 1-5 for locations of SS83 soil borings). The Bootlegger Cove clay is present across the SS83 site between 17 feet to 23.6 feet below ground surface (bgs). Several test pit logs describe the soil interval from 0 to 3 feet bgs as fill. This fill designation may be glacial till; however, based on construction activities and the proximity of the test pits to engineered foundations and roads, the field geologist believes that till is absent or has been reworked across the SS83 site.

### **1.5.6 Hydrogeology**

The primary surface drainage feature in the area of SS83 is Sixmile Creek. Sixmile Creek drains Sixmile Lake to the east and discharges south-southwest into Knik Arm.

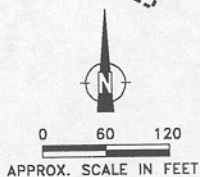
Two aquifers have been identified in the SS83 investigative area: a shallow unconfined system and a deep confined system. The presence of the shallow aquifer is based on lithologic data



# LEGEND

- MONITORING WELL LOCATION
- SOIL BORING LOCATION
- TEST PIT LOCATION

NOTE: TEST PITS SHOWN ARE THE ONLY TEST PITS NOT SHOWN ON SECTION 2 LOCATION MAPS.

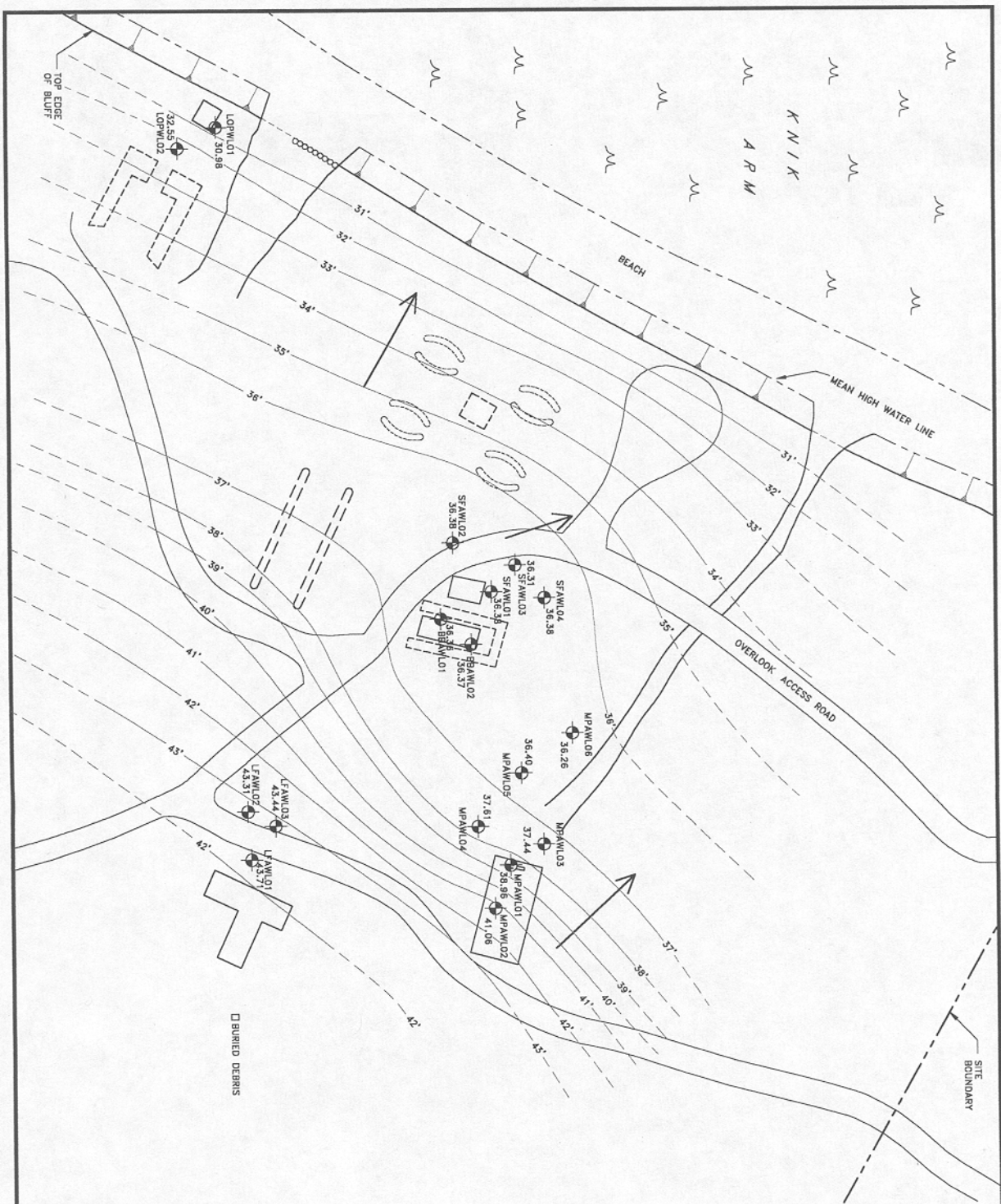


SOURCE:

3 CES/CEVR  
SS83 EE/CA  
ELMENDORF AFB, ALASKA

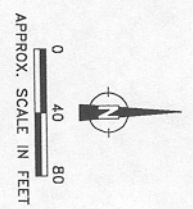
FIGURE 1-5  
SS83 SITE WIDE MONITORING WELL AND  
SOIL BORING LOCATION MAP

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C/SC: 1:120	ZIP: 44/00	PM: J. DONLEY	CHECKED: J. DONLEY
			PROJECT: 9000-230-600



**LEGEND**

- MONITORING WELL LOCATION
- 36' — GROUNDWATER CONTOUR AND ELEVATION
- GENERAL GROUNDWATER FLOW DIRECTION



SOURCE:

3 CES/CEVR  
SS83 EF/CA  
ELMENDORF AFB, ALASKA

FIGURE 1-6  
SS83  
GROUNDWATER CONTOUR MAP

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collected from borings and test pits, as well as water-level data collected from the shallow water table monitoring wells installed during the EE/CA field investigation. The shallow, unconfined aquifer beneath the SS83 site occurs in stratified sand and gravel advance outwash deposits from the Naptowne glaciation. The Bootlegger Cove clay is present beneath the advance outwash deposits at depths between 17 to 23.6 feet bgs. Groundwater in the unconfined shallow aquifer occurs between 14.5 and 22 feet bgs and flows in the northwesterly direction toward the bluff, as shown in Figure 1-6. Discharge of the unconfined aquifer can be observed along the bluff north and south of the SS83 investigative area, where numerous groundwater seeps occur at the contact between the overlying advance outwash deposits and the Bootlegger Cove clay. The presence of a deep, presumably confined aquifer is based on a well log for Well #30, formerly located approximately 130 feet south of the Rosette Antenna site. The Well #30 well log indicates that groundwater is present in gravelly seams within the Bootlegger Cove clay. Well #30 was installed at 261 feet bgs in a gravel and sand bed.

### **1.5.7 Surrounding Land Use**

The current land use designation in the vicinity of the SS83 site is industrial. According to the EAFB Management Action Plan (USAF 1996), the future projected land use will not be different from the current land use. The area north of the site toward Sixmile Creek is designated open space and may be used for outdoor recreation.

### **1.5.8 Sensitive Ecosystems**

As evident in aerial photographs, the majority of the SS83 site was cleared of vegetation and graded during the early 1950s. As of 2000, revegetation in the area has resulted in a forest and woodland habitat type. This habitat consists primarily of mixed black cottonwood, paper birch and white spruce, alders, and willows. Fireweed, grasses, and horsetails are also found throughout the site. Wetlands or other persistent surface water bodies were not encountered within the site boundary.

Shrews, voles, mice, red squirrels, snowshoe hares, porcupines, mink, and beaver are the small mammals that may reside at the site. Brown and black bears, coyotes, red foxes, lynx, and weasels are the predators that may reside at the site. Moose are regularly found in the area, although their concentrations are low (USFWS 1983). Shorebirds are seasonally found in the tide flat areas below the bluff and may include sandhill cranes, loons, and gulls (Gill 1999). Some of the passerines include species of sparrows, warblers, thrushes, chickadees, and swallows. Other birds include bald eagles, hawks, owls, spruce grouse, common raven, and blackbilled magpies. No threatened or endangered species are known to inhabit the SS83 site or nearby habitat. However, the Cook Inlet Beluga Whale was recently listed as a depleted species under the Marine Mammal Protection Act.

To the north of the SS83 site, Sixmile Creek enters a steep-walled ravine and proceeds to the Knik Arm in a series of riffles and plunge pools. Large trees have fallen across the creek, partially obstructing the flow in many areas. The resultant pools provide resting areas for fish

migrating upstream. The lower 250 feet of stream (before extending past the bluff) is under tidal influence. Several anadromous fish species may sporadically enter Sixmile Creek to spawn. Red, Pink, and Silver salmon utilize Sixmile Creek, and the Red salmon continue on to Sixmile Lake. The average year has about 2000 Red salmon spawn in the lake. Natural reproduction maintains a large population of rainbow trout in Sixmile Creek (USFWS 1983).

To the west of the SS83 site, a coastal mudflats community extends below the bluff along the Knik Arm shore. This shoreline, intertidal, subtidal, and open water habitat of Cook Inlet is the only sensitive ecosystem potentially impacted by contaminant migration from the SS83 site. Shallow groundwater within the bluff was observed emerging through seeps along the bluff face at the SS83 site. Further discussion of potential ecological impacts is provided in the streamlined risk evaluation presented in Section 2.4.

### **1.5.9 Meteorology**

The climate of EAFB is greatly affected by local and regional geographic features. Cook Inlet moderates the climate seasonally, while the four surrounding mountain ranges protect the area from Gulf of Alaska storms and extreme winter temperatures from the northern interior (USFWS 1983).

The temperature and precipitation data summarized below for EAFB was collected from 1951 through 1997 (USAF 2001). The average summer temperatures range from 41 to 64° F, and winter temperatures range between 6 and 44° F. The average annual precipitation on EAFB is 16.15 inches, with a range of 13 to 20 inches. The majority of the precipitation falls from July through September when the wind is from the southwest. Snowfall averages 77 inches. The average wind is north at 5.8 knots, and the extreme wind is north-northeast at 53 knots (USFWS 1983).

## **1.6 Basewide Background Soil and Groundwater Data**

Existing background soil and groundwater data is available for use in evaluating site-specific soil and groundwater concentrations measured at SS83. The following subsections describe the background data and how it is to be used in evaluating SS83 site conditions.

### **1.6.1 Soil**

EAFB undertook a background soil-sampling program in 1992 to collect data on metals concentrations in surface and subsurface soil on Base. These data were compiled and analyzed statistically in the EAFB Basewide Background Sampling Report (USAF 1993). These basewide background metals concentrations in soil have been published for comparative use when assessing whether concentrations of metals found at investigation sites represent naturally-occurring background levels or levels representing impact by site activities (USAF 1993). The design of the Basewide background sampling program took into consideration the variability in soil conditions, specifically, the potential difference in metals in alluvial and

morainal deposits, and concentration as a function of depth below ground surface (surface - 0 to 0.5 feet, root zone - 0.5 to 3.0 feet, and deep - 3.0 to groundwater level). Evaluation of the analytical results showed that there was no significant variability between metals concentrations in alluvial and morainal deposits; therefore, these two sample subpopulations were combined and analyzed statistically in order to develop comparable Basewide background metals concentrations.

Eight metals were included as target analytes during the SS83 field investigation: arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. Table 1-1 provides a statistical summary for these 8 metals from the Basewide background sampling program (USAF 1993). Individual onsite data points were compared to the 99<sup>th</sup> percentile upper tolerance limit (UTL) with an associated 95 percent confidence level that has been calculated for each metal at three specific depth ranges. If the onsite value is greater than the UTL, it is highly unlikely that it can be considered a naturally-occurring level.

**Table 1-1. Summary of Basewide Background Soil Concentrations for SS83 EE/CA Metallic Target Analytes.**

Metal	Depth Range	Concentration Summary Statistics (mg/kg)				UTL (mg/kg)
		Minimum	Mean	Maximum	Standard Deviation	
Arsenic	Surface	3.90	7.20	13.10	2.54	16.18
	Root Zone	4.70	6.87	9.60	1.28	11.40
	Deep	3.50	5.46	8.35	1.18	9.24
Barium	Surface	77.3	113.8	154.0	24.9	201.7
	Root Zone	43.4	103.3	171.0	31.4	214.3
	Deep	37.1	54.5	82.5	12.7	95.0
Cadmium	Surface	0.17	1.07	1.95	0.55	3.01
	Root Zone	0.93	1.62	1.90	0.26	2.53
	Deep	0.96	1.63	2.70	0.44	3.03
Chromium	Surface	9.6	19.8	34.3	8.1	48.4
	Root Zone	19.0	31.8	45.3	6.4	54.4
	Deep	18.5	31.6	80.9	13.9	76.1
Lead	Surface	4.30	6.93	11.10	1.80	13.3
	Root Zone	4.10	5.65	7.00	0.89	8.78
	Deep	3.00	5.30	9.10	1.48	10.0
Mercury	Surface	0.050	0.090	0.150	0.029	0.19
	Root Zone	0.040	0.075	0.220	0.044	0.23
	Deep	0.040	0.088	0.165	0.036	0.20
Selenium	Surface	0.055	0.295	0.510	0.113	0.69
	Root Zone	0.045	0.161	0.290	0.089	0.47
	Deep	0.040	0.104	0.400	0.116	N/A
Silver	Surface	0.23	0.63	1.60	0.39	2.00
	Root Zone	0.16	0.51	1.20	0.32	1.62
	Deep	0.15	0.41	0.78	0.20	1.05

Source: USAF 1993.

When evaluating SS83 metals concentrations in soil, site data was first compared to ADEC soil cleanup levels (refer to discussion in Section 2.2). If a site soil sample had a metals concentration greater than the corresponding ADEC cleanup level, the site data was then compared to the background data. This procedure for comparing onsite metals concentrations in soil to background values was used as a screening procedure for determining if additional investigation of metals concentrations in soil at SS83 is warranted. If the site data fell within the background concentrations, then the site sample was not considered an exceedance and was excluded from further risk evaluation (refer to Section 2.3.3).

### 1.6.2 Groundwater

Data collected by the U.S. Geological Survey (USGS) on metals concentrations in groundwater samples collected in the Anchorage Bowl during 1987, 1988 and 1990 were compiled in the EAFB Basewide Background Sampling Report (USAF 1993). While the wells from which these data were compiled are not located in the immediate vicinity of EAFB, the data may be considered to be representative of the metals concentrations that would be expected in uncontaminated groundwater in the EAFB area. This approach to using the USGS groundwater data has been utilized in several of the EAFB operable unit investigations. Table 1-2 provides a statistical summary of the metals concentrations reported in 28 background samples for each of the eight metals except mercury (21 samples) and selenium and silver (10 samples each). Although the USGS data set does not indicate the analytical method used to analyze the groundwater samples, the complete metals data set can be found in Appendix A of the Basewide Background Sampling Report (USAF 1993).

**Table 1-2. Summary of Basewide Background Groundwater Concentrations for SS83 EE/CA Metallic Target Analytes.**

Metal	Concentration Summary Statistics <sup>a</sup> (mg/L)				
	Minimum	Maximum	Mean	Standard Deviation	UTL
Arsenic	0.00100	0.13000	0.02886	0.03361	0.13000
Barium	NA	NA	NA	NA	NA
Cadmium	ND	0.00100	NC	NC	NC
Chromium	ND	0.35000	0.04328	0.08170	0.35000
Lead	ND	0.30000	0.02836	0.06905	0.30000
Mercury	ND	0.00110	0.00027	0.00027	0.00110
Selenium	ND	ND	NC	NC	NC
Silver	ND	0.00100	NC	NC	NC
Note a: Summary statistics as presented in USAF 1995a. NA = Not analyzed for this parameter. NC = Not calculated.					

In evaluating SS83 groundwater metals concentrations, site-specific groundwater results were first compared to ADEC groundwater cleanup standards (18 AAC 75.345, Table C). If a sample result was greater than the corresponding cleanup standard, then the sample result was



compared to the USGS data summary statistics to determine if the site-specific sample result exceeds background levels.

## **1.7 Previous Investigations**

### **1.7.1 Area Under Evaluation Study**

Beginning in 1996, this site was incorporated into the Area Under Evaluation (AUE) discovery process undertaken by EAFB as part of restoration activities conducted under the Air Force's Installation Restoration Program (IRP; USAF 1997). The AUE program was designed to identify and evaluate areas of potential environmental concern that had not been previously identified and/or addressed under any other environmental source discovery efforts at EAFB. Areas with suspicious historical activities, ascertained using aerial photographs, were designated points of interest (POIs). POIs were then considered for Category One No Further Response Action Planned (NFRAP) determinations (USAF 1995b). POIs considered to have potential residual environmental impacts were designated as AUEs, and a preliminary conceptual site model (CSM) was developed to illustrate potential contaminant sources, potential migration pathways, and potential sensitive receptors. AUEs that could pose a potential risk to human or ecological receptors were recommended for further environmental actions and were redesignated as candidate areas of concern (AOCs).

A preliminary site visit was conducted at SS83 in 1996 to observe the current site conditions and to note any indications that contamination might exist. During the site visit, building foundations and what appeared to be several standpipes near the buildings, which were possibly associated with USTs, were observed. There appeared to be a set of standpipes associated with each of the two building foundations observed, possibly indicating the presence of more than one UST. The UST locations appeared to be directly related to the furnace room in at least one of the structures and may have provided heating fuel. There was some evidence of stressed vegetation adjacent to the foundations, particularly in a small area (< 5 square yards) on the north side of the most easterly structure (i.e., the Large Foundation Area). The field team recommended further investigation to confirm or deny the presence of USTs and to evaluate the area around the building structures for contamination.

The SS83 site was originally designated POI 1. Based on the evaluation process outlined above, the site was subsequently redesignated AUE 1. After a historical record review, preliminary site visit, and the development of a conceptual site model, it was determined that the site should be considered a candidate AOC and investigated further.

### **1.7.2 Limited Field Investigation**

EAFB conducted a limited field investigation (LFI) at SS83 in 1997; the site was further investigated in 1998. The investigation included additional review of historical records, as-built drawings, and aerial photographs, as well as interviews conducted with EAFB personnel and a



military historian. A preliminary investigation/site investigation report documented the results of the LFI (USAF 1999b).

The LFI identified and investigated several areas of possible contamination. The individual areas include: the large foundation, motor pool, bermed bunker, small foundation, underground bunker, docking area, and ravine area. Hand borings and small test pits were excavated in these areas. During excavation, headspace samples were collected at intervals of 1 foot and soils were observed for evidence of staining. A polychlorinated biphenyl (PCB) field-test kit (EnviroGard PCB Test Kit) was used at the site to evaluate if PCB contamination was present. This immunoassay test enabled semi-quantitative screening for Aroclor 1016, 1242, 1248, 1254, and 1260. Results were used to assist in determining if PCBs were present.

The LFI report recommended that the site be designated an AOC because the site has several distinct areas where evidence of contamination exists, including the motor pool, the small foundation, the large foundation, and the docking area. Additional investigation was specifically recommended to delineate the extent of contamination at the motor pool pit and northeast corner of the small foundation.

## 2.0 SITE CHARACTERIZATION

The following site characterization sections present information regarding the nature and extent of site contaminants at the SS83 site. Section 2.1 provides information on the 2000 EE/CA field investigation program conducted at the site. Section 2.2, separated by area of investigation, provides detailed physical descriptions, information obtained during previous investigation efforts, and interpretation of the 2000 findings. The results of the 2000 EE/CA investigation were interpreted using a tiered approach that includes evaluating field observations (e.g., field screening results) and comparing sample results to ADEC Methods One and Two cleanup levels. Use of all Method Two soil or groundwater cleanup levels will require ADEC approval. In Section 2.3, a streamlined risk evaluation is used to assess the cumulative carcinogenic and noncarcinogenic site risks estimated from human exposure to site contaminants. The toxicological approach used to evaluate exposure pathways and compare risk estimates to risk management criteria is described in Section 2.3.

### 2.1 EE/CA Field Investigation Program

This section summarizes the field methods that were used in the EE/CA field investigation. General objectives of the EE/CA field investigation were to:

- Verify the source of contaminants;
- Evaluate the area for additional sources of contamination;
- Delineate the extent of soil/groundwater contamination; and
- Fill data gaps as needed to develop removal action alternatives and a site disposition recommendation.

To attain these general objectives, field and analytical programs were developed in the SS83 Engineering Evaluation/Cost Analysis Work Plan (USAF 2000a). The Work Plan was prepared in accordance with the guidelines of the U.S. Environmental Protection Agency (EPA) CERCLA Program; the ADEC Contaminated Sites Remediation Program regulation in Title 18 of the Alaska Administrative Code (AAC), Chapter 75 (ADEC 2000a); UST Program regulations (ADEC 2000b); and Basewide policies and procedures for fieldwork at EAFB as applicable to environmental restoration projects. The field investigation program generally consisted of geophysical investigation, test pit excavation, soil boring/monitoring well installation and sampling, and debris removal. The following sections provide a brief description of each task.

#### 2.1.1 Site Clearances/Permits

All work and associated activities on base were approved by the EAFB Project Manager before the start of field activities. This included the use of photographic equipment. In addition, on-site

activities were coordinated well in advance with the appropriate EAFB facility manager (e.g., 3<sup>rd</sup> Communications Squadron) to ensure that any disturbance to facility operations was minimized.

Before commencement of field investigation activities, the EAFB Explosive Ordnance Disposal (EOD) unit conducted a survey for unexploded ordnance (UXO) throughout the SS83 site. The unit also provided UXO Awareness Training for field personnel involved with the project. The focus of the training included field identification, notification procedures, and evacuation procedures if UXO is encountered. The EOD unit concluded that the possibility of encountering UXO at the SS83 site was low and provided a site clearance to the EAFB Project Manager before the start of field activities.

As indicated in the Work Plan, the EAFB Natural Resources Manager determined that a brush removal/clearing permit was not required for the SS83 site; brush removal activities were conducted as described in Section 2.1.2.

Utility clearances and dig permits were obtained at least 5 days prior to excavation or drilling, in accordance with the procedures required by EAFB in 3<sup>rd</sup> Wing Instruction 32-1007. The field team obtained all permit signatures and coordinated clearance of the areas by appropriate installation personnel before the initiation of subsurface investigations. The field sampling team verified and documented that all utility locates had been completed prior to drilling. A signed and approved copy of the Base Civil Engineer Work Clearance Request (USAF Form 3, EF-V3) was on site at all times during drilling or subsurface investigations.

### **2.1.2 Brush Removal**

Limited brush clearing was conducted in and around several investigation areas to improve site access and visual inspection. Alaska Land Clearing Contractors, L.L.C, conducted brush removal during the week of May 8, 2000. Approximately 20 acres of brush were mulched by two hydroax vehicles on the site. No large trees were removed; clearing was limited to removal of alders and other brush. Minor amounts of large debris from the brush clearing activities were left on site.

### **2.1.3 Visual Inspection**

Visual inspections (site walks) of the SS83 site were conducted prior to and following brush removal to identify additional evidence of hazardous materials, POL storage areas, building foundations, debris, stains, stressed or dead vegetation, unnaturally discolored sediment or surface water, or other indications of hazardous substance impact. Each investigation area was also visually inspected for surface features and infrastructure constraints that would affect subsurface investigation or anticipated removal actions.

As a result of visual inspections, three additional areas of investigation were identified: the Lookout Pad (LOP), the Suspected Landfill Area (LND), and the Drum Bunker Area (DBA). These areas are further described in Section 2.2 .

#### **2.1.4 Geophysical Survey**

Terrasat, Inc., conducted a geophysical investigation at SS83 from May 15 through June 2, 2000. The objectives of the geophysical investigation were to locate and identify potential USTs, pipelines, drums, metal debris, utilities, and landfill areas. Geophysical classification methods—including electromagnetics (EM), magnetometry, and ground-penetrating radar (GPR)—were used to classify buried metallic objects by mass. The geophysical survey discriminated between objects the size of a single drum, clusters of drums, and USTs. GPR was used to aid in further target identification; GPR results also assisted in calibration of the geophysical classification. The classification also provided estimates of the depth of targets.

The geophysical survey was conducted at selected areas using three geophysical instruments:

- Geotronics EM-61 time domain EM meter
- Geometrics cesium vapor magnetometer
- GPR systems

The initial geophysical survey used the EM-61 combined with the magnetometer. This EM profiling involved transmitting a primary signal that was inductively coupled to the earth. Secondary signals were generated in the ground, and both the primary and secondary fields were detected by the EM receiver. Because metallic objects such as cables, communication lines, and steel drums are electrically conductive compared to native soil, they produce anomalous readings that can be measured electronically. Although the EM instrument, an inductive terrain conductivity meter, is sensitive to buried metal objects such as drums and is effective in defining horizontal position, it does not give specific information about the depth to buried objects.

The additional sensitivity and resolution necessary for accurate discrimination of buried material is provided by the magnetometer. The cesium vapor magnetometer measures the strength of the ambient magnetic field as detected by differences in energy associated with the orientation changes of cesium's outer-most electron.

The GPR was used over significant anomalies detected during the EM-61/magnetometer survey to confirm depth and aid in further target identification. GPR systems, which use radar technology to obtain a continuous high-resolution profile of the subsurface, consist of a pulse generator, a transmitting and receiving antenna, and a graphic recorder. GPR transmits a signal that is coupled to the earth by an antenna. When a subsurface signal encounters a boundary between media with different electrical properties (e.g., soils and drums), a portion of

the wave energy is reflected back to the surface, detected by the antenna, amplified, and printed on a graphic recorder.

As described in Appendix A, the following geophysical survey procedures were performed:

- Eight known targets (55-gallon drums) were buried in various configurations at a calibration area within the northeast portion of the site. Using these drums, functional checks of the equipment and software calibration to local site conditions was conducted.
- A grid of perpendicular survey transects was established over selected investigation areas.
- Geophysical data was collect at typical 1-foot (or less) intervals along 5- to 10-foot-spaced survey lines (depending on the area).
- GPR surveys were conducted over significant anomalies to confirm depth and aid in further target identification.
- Exposed utilities were traced with a pipe and cable locator.
- Pertinent information was recorded electronically and documented in a field logbook.

Following the geophysical survey, subsurface investigations were conducted based on preliminary interpretation of the data. Results of the geophysical survey are provided below.

The total area surveyed was approximately 5 acres. Five-foot-spaced grid lines were established across the main site including the MPA, BBA, SFA, UBA, RVA, DKA, and LOP areas. High-resolution electromagnetic and magnetic surveys were conducted at the main site to allow for metal target discrimination and depth estimation. GPR was then used over areas suspected to contain metal targets as indicated from the electromagnetic and magnetic surveys. At the suspected landfill area, a 20-foot grid spacing was established and a low-resolution magnetic survey was conducted.

Appendix A contains the geophysical survey results for SS83. In summary, results of the geophysical survey directed additional investigation using test hole exploratory techniques, which resulted in the discovery of several potential source areas. The following features were investigated based on preliminary geophysical survey results and confirmed with test pit excavations:

- Two USTs at the LFA;
- Two 55-gallon drums west of the MPA;
- Landfill debris;

- Metal debris east of the LFA; and
- Metal debris west of the former bull rail.

Several additional linear features were excavated during test pit operations, which also show up on the geophysical survey results. These features include:

- Three stacked 2-inch diameter steel pipes with communication cable inside running from the southeast corner of the BBA;
- The wood stave pipe extending from the northwest side of the DKA to the south side of the RVA;
- Several communications cables extending from the DKA to the artillery revetments and the UBA.

### **2.1.5 Test Pit Excavations**

The purpose of the test pit excavations was to determine subsurface soil conditions and to aid in determining the nature and extent of subsurface contamination. Test pits were excavated at the LFA, MPA, BBA, SFA, UBA, RVA, DKA, and at the three additional areas (the LND, LOP, and DBA). Test pits were used for logging soil conditions, collection of subsurface soil samples, and documentation of buried debris, USTs, and utilities. The geologist supervising the operation maintained a complete log of conditions encountered during excavations. Test pit logs and associated laboratory geotechnical data generated during the SS83 EE/CA field investigation are presented in Appendices B and C.

Test pits were excavated in two stages. Stage I test pit excavations were conducted in June and July 2000 with a backhoe fitted with a 1.5-foot wide bucket. These test pits were advanced before the receipt of the geophysical results. The purpose of Stage I test pits was to simultaneously remove soil filled drum berms while investigating subsurface conditions beneath selected berms. Stage II test pit excavations were conducted in September 2000, with a track-mounted excavator fitted with a 3-foot bucket. The purpose of Stage II test pit excavations was to confirm the presence of metal targets identified in the geophysical survey report (Appendix A) and to further determine the nature and extent of subsurface contamination.

Samples from test pits were collected in accordance with procedures outlined in the *Underground Storage Tank Standard Procedures Manual* (ADEC 2000b). At test pit locations, the sample with the highest ambient temperature headspace (ATH) or immunoassay (when applicable) screening results was typically selected for laboratory analysis.

### 2.1.6 Soil Borings

The EE/CA investigation as outlined in the Work Plan included installing 17 soil borings and completing the borings as monitoring wells. However, five additional soil borings (not completed as monitoring wells) were installed for the following reasons:

- Groundwater was not encountered during drilling of a soil boring;
- Underruns in total drilling footage allowed additional investigation at areas where field observations warranted further investigation; and
- Further investigation was warranted around USTs where installing a well was not feasible.

A complete log of conditions encountered during drilling was maintained by the geologist supervising the operation. Soil boring logs are presented in Appendix D; associated laboratory geotechnical data generated during the SS83 EE/CA are presented in Appendix C.

Borings were installed with a truck-mounted CME-75 hollow-stem auger drill rig. Soil borings not completed as monitoring wells were abandoned with volclay grout to the surface. Section 2.1.8 describes the standard monitoring well construction procedures.

In general, subsurface soil samples were collected from borings for soil description or chemical analysis at 5-foot intervals to groundwater. A soil sample was collected as close to the saturated zone as possible to characterize potential contamination at the soil/water interface. Identification of soil lithology between split-spoon samples was based on inspection of soil cuttings discharged from the augers. Soil samples submitted for chemical analysis were collected with a 2.5-inch inner diameter split-spoon sampler driven ahead of the augers into undisturbed soil. All sample intervals were field screened using ATH with a photoionization detector (PID) as described in Section 2.1.7. The PID was maintained in accordance with the manufacturer's specifications and was calibrated with 100 parts per million (ppm) isobutylene once daily at a minimum.

In general, a minimum of two soil samples from each boring were sent to the laboratory for analysis. Typically, the sample at or just above the water table and the sample with the highest ATH screening results were selected from each boring. Samples not chosen for laboratory analysis were placed in 55-gallon drums with the soil cuttings from that boring.

Soil samples were placed in containers in the following order: 1) gasoline range organics (GRO) and benzene, toluene, ethylbenzene, and total xylenes (BTEX); 2) volatile organic compounds (VOC); 3) diesel range organics (DRO), residual range organics (RRO), and polycyclic aromatic hydrocarbons (PAH); 4) PCBs; 5) metals; 6) total organic carbons (TOC); and 7) geotechnical parameters. Samples for volatile analysis were collected first from undisturbed soil. The samples for nonvolatile analyses were collected from soil that was first homogenized in a

stainless steel bowl with a stainless steel spoon. The stainless steel spoon and bowl were decontaminated between each sample location and sample depth as described in Section 2.1.14. Sample containers were labeled with the sample number, analytical parameters, and date and time of collection.

Soil properties required for fate and transport modeling include the soil porosity, bulk density, hydraulic conductivity, and organic carbon content. Ten 5-gallon buckets and eleven brass liners containing samples from both the unsaturated and saturated zones were submitted for analysis by the following methods:

- Sieve analysis in accordance with the American Society for Testing and Materials (ASTM) S422 “Standard Test Method for Particle Size Analysis of Soils”;
- Specific gravity in accordance with ASTM D584 “Standard Test Method for Specific Gravity in Soils”;
- Hydraulic conductivity in accordance with ASTM D5084 “Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter,” or in accordance with ASTM D2434 “Standard Test Method for Permeability of Granular Soils (Constant Head)”;
- Bulk density.

Geotechnical results are presented in Appendix C.

### **2.1.7 Field Screening**

#### **2.1.7.1 Petroleum Hydrocarbons and Volatile Organics**

Subsurface soils collected from test pits and soil borings, and surface soil samples were field screened using the ATH method in conjunction with a PID and by visual and olfactory observations. ATH measurements were used to determine the lateral and vertical limits of contamination, to assist in the decisions pertaining to the selection of samples for analysis, and decision-making associated with disposal. All soil samples were field-screened using the ATH method, as follows. A clean Ziploc® bag was partially filled (one-third to one-half) with soil immediately after extracting the soil from its in-situ position. Headspace vapors were allowed to develop in the bag for at least 10 minutes but less than 1 hour. The bag of soil was agitated for 15 seconds at the beginning and end of the headspace development period to assist volatilization. The bag of soil was maintained at a minimum temperature of approximately 40°F. The PID was then side-punched into the bag, to a point about one-half the headspace depth. Care was taken to avoid uptake of water or soil. The highest meter reading was recorded on the soil boring logs at the appropriate depth.



ATH/PID values in combination with odor and elevated analytical results from associated samples were generally interpreted as positive indicators of petroleum hydrocarbons. Elevated ATH/PID values not accompanied by odor or positive results from laboratory analyses were considered potentially suspect and possibly due to interference from moisture or equipment malfunction.

Soils that obtained PID readings below 1 ppm and exhibited no visual/olfactory signs of contamination were considered clean and were spread on site after receipt of laboratory confirmation samples. Soils exhibiting a PID reading of 1 ppm or higher and a fuel odor were considered contaminated and stockpiled on site before final disposition as described in Section 2.1.15.

### **2.1.7.2 Polychlorinated Biphenyls**

Surface soil samples collected from 0.5 to 1.0 feet bgs at the LFA, DKA, and LOP were field-screened using Ensysis® PCB immunoassay field test kits. Surface soil samples were collected using stainless steel trowels or stainless steel spoons. Soil was placed in resealable Ziploc® bags, and bags were labeled and placed in a cooler. The immunoassay test kits were used to determine the range of PCBs present in soil. Any samples that had positive detection of PCBs were repackaged in sample jars, labeled, and sent off site to primary and quality assurance (QA) laboratories for confirmation analysis.

### **2.1.8 Monitoring Well Installation**

Monitoring wells were installed at the LFA, MPA, SFA, BBA, and LOP. Monitoring well installation locations were selected based on:

- Presence or absence of groundwater above the confining layer;
- Results of the geophysical survey;
- Observations made during test pit excavations; and
- Assumed groundwater flow direction.

Selected monitoring well locations were adjusted as necessary based on the location of overhead obstructions (i.e., tree limbs), structures, and field observations.

A project geologist supervised the drilling and well installation and prepared soil boring and monitoring well logs. Soil samples were collected as described in Section 2.1.6. Monitoring wells were screened in the unconfined aquifer.

### **2.1.8.1 Monitoring Well Construction**

Monitoring wells were constructed of 2-inch diameter 0.01-inch machine-slotted, 10-foot, Schedule 40 polyvinyl chloride (PVC) screen with Schedule 40 PVC riser of requisite length. The screen and riser pipe were coupled with threaded joints sealed with a viton O-ring. No PVC glue or solvent was used in the well construction. The annulus between the screen and the borehole was backfilled with No. 20-40 silica sand, which was selected based on knowledge of the formation material. In general, the sand pack extends to approximately 2 feet above the screen, with a minimum 2-foot-thick bentonite chip seal placed on top of the sand pack. The annulus above the bentonite chips is sealed with volclay grout slurry to approximately 2 feet bgs.

All monitoring wells were completed with steel flush-mounted security covers. The flush-mount covers were permanently stamped with monitoring well designation numbers which correspond to the monitoring well identification number recorded in the SS83 field logs. The U.S. Army Engineer District-Alaska (USAED-AK) assigned AP-numbers to the monitoring wells at the completion of the fieldwork. The corresponding AP numbers are also shown on the SS83 boring logs and well construction diagrams as the permanent well number. The steel flush-mount security casings are set in concrete. The PVC well casing inside the flush-mount cover is fitted with a locking, watertight expandable well plug. At the time of well completion, all wells were flagged with a 6-foot-high orange, triangular bicycle whip flag imbedded into the cement of the security flush mount.

### **2.1.8.2 Well Development**

Monitoring wells were developed no sooner than 24 hours after the final completion of the well to allow the concrete and grout sufficient time to set. Monitoring wells were developed between July 6 and July 12, 2000. The purpose of well development is to remove any fine sand or silt particles that may have settled around the well screen during installation. Development also enhances the hydrologic connection between the well and the aquifer.

Two types of well pumps were used during development. Wells that exhibited slow recharge were developed using a Waterra Pump fitted with dedicated Teflon tubing. Wells that exhibited rapid recharge were developed using a Grundfos pump fitted with dedicated Teflon tubing. In general, the development procedure involved surging and pumping of the wells until five well volumes of water were removed, the discharged water was relatively sediment-free, and water quality parameters stabilized. During development, the purged water was measured for pH, specific conductivity, temperature, turbidity, dissolved oxygen, and salinity. Measurements were taken after each well volume was removed. These measurements, as well as observations of water clarity, were recorded in the field logbook. The wells were considered developed after the above-mentioned parameters met with the criteria established in the SS83 Work Plan. Water from well development was collected in 55-gallon drums and transported and staged at the

Environmental Staging Facility (ESF) awaiting analytical results before disposal (refer to Section 2.1.15).

### **2.1.9 Groundwater Sampling**

Monitoring wells were sampled no sooner than 48 hours after development. Primary groundwater sampling occurred on July 12 through July 14, 2000. Three wells were resampled on August 9, 2000, because QA samples were received at the USAED-AK QA laboratory in excess of the temperature goal of 4°C.

Immediately before purging, the static water level and total well depth were measured from the top of each well's inner PVC casing and recorded in the field logbook. Wells were sampled after a minimum of three well casing volumes were purged and three consecutive water quality measurements indicated that the well formation water had equilibrated. The wells were purged and sampled by hand bailing with a Teflon bailer. Observations made during sampling, such as presence of odor or sheen, were recorded in the field logbook. Water level and total well depth measurements were measured and recorded again in the field logbook at the completion of groundwater sampling. Equipment decontamination water and groundwater purged during well sampling was containerized in 55-gallon drums and transported and staged at the ESF as described in Section 2.1.15.

### **2.1.10 Field Quality Control Samples**

The SS83 analytical program consisted of submitting primary and quality assurance/quality control (QA/QC) samples to the laboratories for analysis as described in the SS83 EE/CA Work Plan.

The following field quality control (QC) samples were collected:

- Field duplicates and QA referee samples were collected at a rate of 10 percent for the entire SS83 field program. Field duplicates were submitted "blind" to the project laboratory.
- Laboratory-prepared trip (transfer) blanks of analyte-free media accompanied each batch of samples submitted for GRO/BTEX and VOC analysis and were submitted "blind" to the project laboratory.
- Matrix spike/matrix spike duplicate (MS/MSD) samples were collected at an overall rate of 5 percent for the entire project.
- A rinsate blank (equipment blank) was collected by rinsing the disposable bailer with deionized water.

Primary samples were analyzed by CT&E Environmental Services, Inc., in Anchorage, Alaska. Samples for geotechnical analysis were analyzed at Alaska TestLabs in Anchorage, Alaska. QA samples were analyzed by Sound Analytical Services located in Tacoma, Washington.

### **2.1.11 Sample Management**

#### **2.1.11.1 Sample Identification**

Samples collected during the field investigation were each assigned a unique field sample identification alphanumeric code and labeled accordingly. This field sample identification code contains information traceable to the site, location, and replicate, and other information unique to that sample. This system was developed to allow for sample control of the large number of samples that were collected during this and any following investigations. Each sample identification number consisted of a three-segment alphanumeric code that identifies the sampling location, the sample identifier, the type of sample, and the QC identifier. Sample numbers were defined as follows:

- 1) Site Designation. The first segment of the sample identification number is the area designation number (3 characters). The following area designations were used for this investigation:

LFA = Large foundation area  
MPA = Motor pool area  
BBA = Bermed bunker area  
SFA = Small foundation area  
UBA = Underground bunker area  
RVA = Ravine area  
DKA = Docking area  
LOP = Look out pad  
LND = Landfill area  
DBA = Drum bunker area

- 2) Location Designation. The next four characters represent the location within the sites where the samples were obtained, namely: AANN, where A = alpha code designating the type of sample and N = the sequential number assigned. Groundwater field duplicate samples were given a fictitious sequential number so that the laboratory was unaware which primary sample it was duplicating. The following codes were used during this investigation:

SL = Surface location  
BH = Borehole

- TP = Test pit excavation
- WL = Well
- 3) Matrix Code. The next two characters indicate the sample matrix. The following codes were used during this investigation:
- DC = Drill cuttings
- SO = Soil
- WG = Groundwater
- WQ = Water quality control matrix
- 4) Sample Depth. The next set of numerals indicates the depth below the surface to the top of the soil sample collection interval in feet and tenths of feet (e.g., 2.5 or 17.5). This part of the code was used only for soil samples. Field duplicate samples were given a fictitious depth so that the laboratory was unaware which primary sample it was duplicating.
- 5) Sample Type. The next set of characters represents the field sample type. The following code was used for all samples during this investigation:
- N# = Normal environmental sample

The # symbol represents a numeral that is sequentially assigned by additional sample types collected from one location. Laboratory matrix spike and matrix spike duplicates on a single sample were identified together as an MS/MSD sample type. For a soil sample collected from boring WL01 at the Motor Pool Area (MPA) from 5 to 7.5 feet bgs, the sample number would be:

**MPAWL01SO5.0N1**

Each sample container was labeled with project number, site name, sample number, date and time of sample collection, any preservatives used, and analyses requested. Individual sample labels were affixed to the sample containers. Waterproof, indelible ink was used to ensure the integrity of the sample identification code.

#### **2.1.11.2 Sample Packaging and Transport**

Plastic bubble wrap was used to line the bottom of shipping coolers. Samples were placed upright in coolers. Completed chain-of-custody forms were placed inside a resealable plastic bag and secured to the inside of coolers for shipment to the USAED-AK QA laboratory. The chain-of-custody form was hand-delivered along with the sample coolers to the primary laboratory in Anchorage. Space between samples in the coolers was filled with packing material (bubble wrap) so that samples were protected and movement limited. Cold packs were

placed around and on top of the samples to maintain the temperature goal of 4°C. A temperature blank consisting of at least 500-milliliters (mL) water in a high-density polyethylene (HDPE) bottle accompanied every cooler transporting project samples to the laboratory. Coolers were sealed with chain-of-custody tape on the front right and back left corners. Before the coolers were sealed, the chain-of-custody tape number was recorded on the chain-of-custody form. Packaging tape was placed around the cooler using a minimum of two full wraps.

### **2.1.11.3 Field and Sample Custody Documentation**

When a transfer of samples occurred, the chain-of-custody form was completed with the name of the person relinquishing the samples, and the person receiving the samples signed and dated the form. Sample coolers were hand delivered to:

CT&E Environmental Services, Inc.  
5633 B Street  
Anchorage, AK 99518

Samples analyzed for physical characteristic parameters were hand delivered to:

Alaska TestLabs  
4040 B Street  
Anchorage, AK 99503

QA samples were shipped by Federal Express delivery to Sound Analytical Services in Tacoma, Washington.

### **2.1.12 Field Documentation**

Field documentation contains information pertinent to the field sampling program and the equipment preparation efforts. Field documentation was recorded on bound logbooks with numbered pages, in indelible ink. Corrections to any documentation were made by drawing a single line through the incorrect entry and initialing the correction. No documentation pages were removed from any field logbooks.

Field documentation was maintained by the field team leader during field activities and transferred to the project files for a record of sampling.

Field and sample documentation consisted of the following:

- Field Activity Logbook. This logbook was assigned to the field team leader to summarize daily field activities and to document required field briefings (such as health and safety briefings). This logbook was also used to record the field team's activities and observations; the identifiers of the locations of samples collected that day; any unusual occurrences affecting the overall project; and weather conditions.

Further, the field logbook was used to document equipment calibration; decontamination; health and safety monitoring; and subcontractor activities (including performance, down time, etc.).

- Test Pit Log. The test pit log was used to document excavation activities and associated sampling. The test pit log includes the name of the equipment operator; the equipment used; descriptions of lithology; sample collection date and time; method of collection; headspace screening results; and any other test pit observation relevant to the investigation. Test pit logs are provided in Appendix B.
- Boring Logs and Monitoring Well Construction Logs. The boring logs and monitoring well construction logs specifically document drilling activities. Documentation includes the name of the drilling subcontractor; drilling method; rig type and size; equipment diameter; boring number; blow counts; boring diameter; sampling depths; descriptions of lithology; well construction material and diameter; screen type, depth, and size; boring annulus completion material and depth of placement; water levels; well head completion and well security information; collection date and time; method of collection; headspace screening results; and any other observation relevant to the investigation. Soil samples were classified using the Unified Soil Classification System (USCS) and were described per ASTM D-2488, including color, texture, moisture content, grain texture, sedimentary features, staining, and odors noted during field activities. Surface and subsurface observations were recorded in a field logbook and boring logs. Boring logs and well construction logs are provided in Appendix D.
- Well Development and Groundwater Sample Collection Records. Well development and groundwater sample collection records were completed during well development and sampling, and included the following information:
  - date and time of purging and sampling,
  - depth to water and total depth of the well,
  - visual condition of each well and water purged from the well,
  - field parameter results (pH, dissolved oxygen, specific conductivity, turbidity, and temperature),
  - volume of purge water removed, and
  - method of sampling.
- Electronic Sample Log. An electric sample log was completed as samples were prepared for delivery to the laboratory. This accounted for all samples collected and provided a basis for sample tracking.
- Chain-of-Custody Records. Chain-of-custody record forms were completed to document each sample sent for laboratory analysis. The chain-of-custody forms

summarized sample information (project, sample location, date and time of sampling, sample identifier, and analyses required) and provided a complete record of sample custody, from the point of sampling through receipt by the analytical laboratory.

- Photography. Each investigation area within SS83 was photo documented. Photographs were also taken of soil samples that showed contamination or sedimentary features and of groundwater samples to document groundwater sample clarity. Additionally, photographs were taken of any unusual site conditions that were encountered. The location, time, film frame and roll number, and brief description of the photograph was recorded in the field logbook. Photographs are provided in Appendix E.

#### **2.1.13 Field Equipment Calibration**

A PID (Model 580EZ) was used to field screen soil for volatile compounds. The PID was factory calibrated before its use on the SS83 field job. The PID was calibrated by the field team prior to use and recalibrated during the day as needed (e.g., if PID drift was noted). The PID was calibrated in accordance with the owner's manual using a 100-ppm isobutylene reference gas in clean ambient air as the zero reference gas.

The Horiba U-10 water quality instrument was used during the well development and sampling activities. The calibration solution provided by the manufacturer was used to calibrate the Horiba U-10 on days of operation.

#### **2.1.14 Decontamination Procedures**

All field equipment that came in contact with potentially contaminated soil or was used for sampling was decontaminated before and after use. Clean, chemical-resistant gloves were worn by persons decontaminating tools and equipment. Soil sampling tools, including split spoons, trowels, spoons, and shovels, were cleaned by the following process:

1. scrub in clean water,
2. scrub with a brush in a solution of Alconox and water,
3. rinse twice in clean water, and
4. rinse with deionized water.

Specific decontamination procedures for various types of field equipment are as follows:

- Excavation equipment was decontaminated by cleaning with potable water rinse, scrubbing with a brush and solution of Alconox and water, and rinsing with potable water between excavations and drum sampling activities, and before moving off site at the end of the field investigation.



- Auger flights, rods, and bits were decontaminated by cleaning with high pressure hot water at the beginning of the project, between boreholes, and before moving off site at the end of the field investigation.
- Well sounders and water quality probes were rinsed with potable water, scrubbed with potable water and Alconox solution, rinsed with potable water, and rinsed with deionized water.
- PVC casings, screen caps, risers, and covers were still in the factory-sealed packing and therefore were considered sufficiently clean for installation without steam cleaning.

#### **2.1.15 Investigation-Derived Waste**

Several types of investigation-derived waste (IDW) were generated during the 2000 SS83 field investigation. IDW consisted of the following:

- Soil excavated from test pits
- Soil-filled drums removed from bunker berm walls
- Soil cuttings from boreholes
- Decontamination water associated with borehole drilling and soil sampling
- Well development and purge water
- Wood debris
- Concrete debris
- Scrap metal
- Water/fuel mixture from USTs
- Disposable personal protective equipment (PPE) and sampling equipment

IDW management procedures were detailed in the SS83 EE/CA Work Plan (USAF 2000a). These procedures were developed in accordance with EAFB guidance, specifically the *3<sup>rd</sup> Wing OPLAN 19-3, Hazardous Waste, Used Oil, and Hazardous Material Management Plan (September 1998)* and the *Basewide Environmental Staging Facility Operations and Maintenance Plan (March 1993)*.

During the field investigation, an IDW inventory was prepared and updated as IDW was generated. The inventory included information on each drum (or other type of storage

container) containing IDW, such as drum number, contents, source area within SS83, and staging location. As analytical results for IDW became available, the inventory was updated to include results for the samples that are representative of IDW, an evaluation of regulatory status and nature of IDW contamination, and proposed disposition of the IDW. Finally, following disposal or turn-in of IDW, the final disposition of the IDW was noted in the inventory. A copy of the completed IDW inventory is included in Appendix F.

IDW was staged both at the SS83 site and at the 3<sup>rd</sup> CES/CEVR ESF. Types of IDW staged at SS83 generally consisted of material that required stockpiling and consisted of the following:

- Soil excavated from test pits (stockpiled and drummed)
- Soil-filled drums removed from bunker berm walls
- Wood debris
- Concrete debris
- Scrap metal

Short-term stockpiles (for up to 180 days) were constructed on top of existing concrete building foundations. For each stockpile, a 10-mil reinforced liner was used as the bottom liner, with sandbags placed under the liner around the perimeter to form a berm to prevent run-on of water onto the liner. A 6-mil reinforced top liner was used to protect each stockpile from the weather. The edges of the top liner were lapped over the bottom liner and berms to prevent water from running through the stockpiled soil.

Palletized drums of soil were also placed on top of the concrete building foundations. Concrete and scrap metal debris were consolidated into distinct stockpiles near the designated main staging area at SS83, and wood debris was stockpiled near its source area (the DKA).

IDW staged inside the ESF consisted of the following drummed material:

- Soil cuttings from boreholes
- Decontamination water associated with borehole drilling and soil sampling
- Well development and purge water

Each drum had a unique identification number to facilitate drum tracking. Drums were also marked to show information regarding the contents, origin, date of generation, and the point of contact name and telephone number. Drums were placed on wood pallets.

IDW was staged pending receipt of analytical results that were used to characterize the IDW. Once IDW was properly characterized and its final disposition determined, arrangements were made for IDW transport off of SS83 and IDW turn-in or treatment, as appropriate.

Management of specific IDW streams is described below. Appendix F contains the inventory of all IDW generated during the SS83 field investigation. For any IDW that was taken off of EAFB for treatment or final disposition, Appendix F also contains documentation of the treatment or final disposition.

#### **2.1.15.1 IDW Soil**

IDW soil was drummed or stockpiled depending on the area of SS83 being investigated, potential contaminants, and anticipated IDW management procedures. A summary of how IDW soil was managed is provided below, with details provided in Appendix F.

- At the LFA and DKA, PCBs were initially the contaminants of concern. Shallow soil removed from the test pits (top 2 feet) at these two areas was drummed in case PCBs were detected and soil required off-site disposal. Based on PCB field screening and laboratory results, this soil was determined to be clean soil and was either spread on site or used to backfill the test pit from which the soil was originally removed. Soil from LFATP01 (no PCBs detected) also contained petroleum hydrocarbons in excess of ADEC Method One Level A and was thermally remediated and then used as fill material on base (JE, 2001).
- Soil removed from beneath 2 feet bgs from the LFA test pits was initially determined to be impacted by petroleum hydrocarbons based on field observations and PID screening; this soil was therefore placed in Stockpile No. 1. Laboratory samples associated with this soil contained petroleum hydrocarbons in excess of ADEC Level A, and the soil was thermally remediated and then used as fill material on base (JE, 2001).
- Soil removed from the BBA and SFA test pits was initially determined to be impacted by petroleum hydrocarbons based on field observations and PID screening. This soil was therefore placed in Stockpile No. 2. Laboratory samples associated with this soil contained petroleum hydrocarbons in excess of ADEC Level A, and the soil was thermally remediated and then used as fill material on base (JE, 2001).
- Soil removed from the LOP test pit was initially determined to be impacted by petroleum hydrocarbons based on field observations and PID screening. This soil was therefore placed in Stockpile No. 3. Laboratory samples associated with this soil contained petroleum hydrocarbons in excess of ADEC Level A, and the soil was thermally remediated and then used as fill material on base (JE, 2001).

- Soil removed from the MPA pit was initially determined to be impacted by petroleum hydrocarbons based on field observations and PID screening. The excavated soil also contained oil filters and oil cans, further supporting the presumption that the pit had been used during vehicle maintenance. Because of the potential for metals concentrations that could cause the soil to be a characteristic hazardous waste, this soil was stockpiled separately in Stockpile No. 4. Laboratory samples associated with this soil contained petroleum hydrocarbons in excess of ADEC Level A. In addition, lead was present at concentrations in excess of 20 times the Resource Conservation and Recovery Act (RCRA) toxicity characteristic, indicating that the soil is likely a RCRA characteristic waste. This soil was drummed (40 drums) and turned in to the Defense Reutilization and Marketing Office (DRMO) for disposal as a hazardous waste.
- Soil removed from test pits at the UBA was initially drummed pending receipt of analytical results. Laboratory results showed that the soil was not impacted by petroleum hydrocarbons, and the soil was spread on site.
- All soil cuttings from the drilling of boreholes were drummed at the time of generation. Based on analytical results, soil that achieved ADEC Level A was spread on site, and soil that exceeded Level A was thermally remediated and then used as fill material on base (JE, 2001).

#### **2.1.15.2 IDW Water**

All IDW water was placed in bung-topped 55-gallon drums and was labeled and staged as previously described. The majority of IDW water consisted of well development and purge water. This IDW water was not sampled following generation, as groundwater samples could be closely correlated to the wells from which IDW water was generated. Groundwater samples were analyzed for petroleum hydrocarbons, RCRA metals, VOCs, and semi-volatile organic compounds (SVOCs; i.e., PAHs). Evaluation of these results indicated that chlorinated solvents were not detected, and RCRA metals concentrations did not cause the water to be a hazardous waste. The only IDW water that was sampled following generation was site-wide decontamination water; this water was analyzed only for RCRA metals, as it had already been shown that chlorinated solvents had not been detected on site.

Therefore, all 16 drums of IDW water were determined to be impacted, if at all, only by petroleum hydrocarbons and were therefore processed in the conditioning system at the 3 CES/CEVR ESF. The IDW inventory in Appendix F provides details on each drum of IDW water.

### **2.1.15.3 Non-Hazardous Debris**

Concrete debris generated during the SS83 field investigation was transported to the EAFB LF05 landfill for use as cover material. Wood debris was hauled off site and disposed at the Municipality of Anchorage Regional Landfill.

Scrap metal was turned over to EAFB (3 CES/CEV) for recycling. Scrap metal consisted of approximately 50 drums (filled with soil) removed from the BBA; 41 empty drums removed from the bluff below the RVA drum wall; two heaters from the DKA (inspected to ensure no insulation or liner could potentially contain asbestos); and miscellaneous piping. Before turning scrap metal over to EAFB, ENSR discussed the need for decontamination of scrap metal drums with 3 CES/CEV personnel. It was agreed that none of the scrap metal drums would require decontamination, since all scrap metal drums had been either filled with what was determined to be clean soil (bermed bunker drums) or found empty with no residue (ravine bluff). Some drums did possess a tarry residue; however, 3 CES/CEV personnel determined that these drums were acceptable for recycling without first being decontaminated. All scrap metal was crushed before placement in a roll-off bin provided by EAFB.

The IDW inventory in Appendix F provides details on the non-hazardous IDW generated at SS83; Appendix F also provides documentation of any off-site final disposition.

### **2.1.15.4 Other IDW**

As described in Section 2.1.4, two USTs were found and unearthed during the SS83 field investigation. The tanks were found to contain a fuel/water mixture that required removal and disposal. Tank 1 (500-gallon capacity) contained approximately 325 gallons of fuel product and approximately 150 gallons of water; Tank 2 (1,000-gallon capacity) contained approximately 25 gallons of fuel product and approximately 200 gallons of water. Neither tank contained a measurable sludge layer. Samples drawn from each tank were analyzed to ensure that the fuel product was diesel fuel. Alaska Pollution Control pumped the fuel/water mixture from the USTs and transported it to their facility for petroleum recycling and water treatment. The IDW inventory in Appendix F provides details on this IDW stream; Appendix F also provides documentation of the IDW disposition.

### **2.1.16 Site Survey**

All monitoring well and soil boring locations were surveyed by Tryck Nyman Hayes Inc., an Alaska-registered surveyor. Additional features were also surveyed, including several test pit locations, the (0,0) coordinate for the geophysical survey, and the two USTs at the LFA. All survey data were established relative to the Municipality of Anchorage datum and the U.S. Air Force (USAF) identified benchmark (TTAN7) located on EAFB. The vertical datum for this survey was based on the Alaska State Plane Coordinates. This control is the same datum used for the 1986 Elmendorf Master Plan. SS83 survey data are presented in the boring logs (Appendix D).

## **2.2 Nature and Extent of Contamination**

This section provides information regarding the nature and extent of contamination present at each of the 10 SS83 investigation areas. For each area, critical information about the identified contaminant types and sources, the extent of impacted soil or groundwater, and the presumed or known groundwater flow direction is provided. Information is also provided regarding infrastructure constraints that may affect remedial action objective and alternatives. Each area-specific section includes:

- physical description,
- previous investigation results,
- field investigation results,
- field screening results, and
- analytical laboratory results.

Photographs of each investigation area are provided in Appendix E. A data assessment was performed on all laboratory data associated with the SS83 EE/CA. The Data Assessment Report in Appendix G provides an assessment of field duplicates and includes an interpretation of sample chromatograms for petroleum hydrocarbon analysis.

Soil and groundwater analytical results were compared to applicable ADEC cleanup levels that were selected based on the physical characteristics of the SS83 site, the anticipated disposition for the area, and the relative magnitude of site contamination encountered. Specifically, analytical soil results were initially compared to the most stringent ADEC Method Two soil cleanup levels, typically the ingestion-based levels or the migration-to-groundwater cleanup levels. These soil cleanup levels are provided in Table 2-1.

Although groundwater at the SS83 site is neither a current nor reasonably anticipated source of drinking water, analytical groundwater results were compared to groundwater cleanup levels established in Table C of the CSRP and provided in Table 2-1.

### **2.2.1 Drum Bunker Area**

#### **2.2.1.1 Physical Description**

The DBA is located east of the Rosette Antenna. The DBA is a westerly facing “U” shaped structure constructed of approximately 300 soil-filled 55-gallon drums (Figure 2-1). The soil-filled drum berm is constructed such that the drums are stacked two drums high and four drums deep. The top and exterior facing drums are covered with a mound of soil approximately 3 feet deep. Approximately 10 feet south of the exterior of the southern drum wall is a 25 foot

**Table 2-1. SS83 EE/CA Site Cleanup Levels\***

	Method Two			Groundwater Cleanup Level
			Migration-to-Groundwater	
	Ingestion	Inhalation		Table C Levels
	(mg/Kg)			(mg/L)
Petroleum Hydrocarbons				
Gasoline Range Organics	1,400	1,400	300	1.30
Diesel Range Organics	10,250	12,500	250	1.50
Residual Range Organics	10,000	22,000	11,000	1.10
BTEX Compounds				
Benzene	290	9	0.02	0.005
Toluene	20,300	180	5.4	1.0
Ethylbenzene	10,000	89	5.5	0.7
Xylenes	203,000	81	78	10.0
PAHs				
Acenaphthene	6,100	na	210	2.2
Acenaphthylene	na	na	na	na
Anthracene	30,000	na	4,300	11.0
Benzo(a)anthracene	11	na	6	0.001
Benzo(b)fluoranthene	11	na	20	0.001
Benzo(k)fluoranthene	110	na	200	0.01
Benzo(g,h,i)perylene	na	na	na	na
Benzo(a)pyrene	1	na	3	0.0002
Chrysene	1,100	na	620	0.1
Dibenz(a,h)anthracene	1	na	6	0.0001
Dibenzofuran	na	na	na	na
Fluoranthene	4,100	na	2,100	1.46
Fluorene	4,100	na	270	1.46
Indeno(1,2,3-cd)pyrene	11	na	54	0.001
2-Methylnaphthalene	na	na	na	na
Naphthalene	4,100	na	43	1.46
Phenanthrene	na	na	na	na
Pyrene	3,000	na	1,500	1.1
Metals				
Arsenic	6	na	2	0.05
Barium	7,100	na	1,100	2.00
Cadmium	100	na	5	0.005
Chromium	510	na	26	0.10
Lead	1,000 <sup>†</sup>			0.015
Mercury	na	18	1.4	0.002
Selenium	510	na	3.5	0.05
Silver	510	na	21	0.18

**Key:**

\* ADEC cleanup levels per 18 AAC 75.

<sup>†</sup> Lead cleanup levels are site-specific; 1,000 mg/Kg is appropriate for industrial land use.

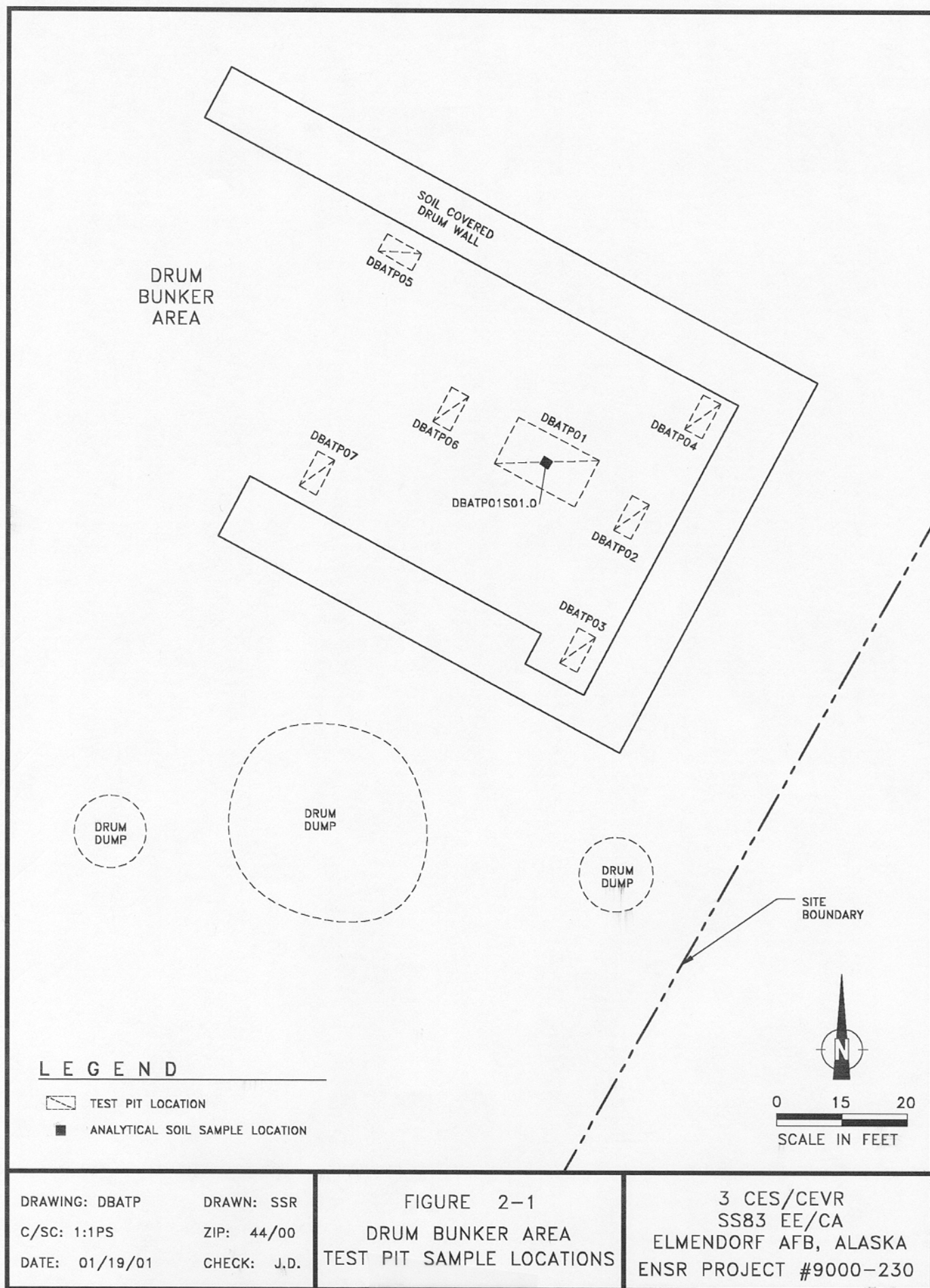
na = No ADEC cleanup level available.

**Notes:**

Shaded boxes represent the most stringent cleanup level for each chemical.

Other than toluene, no volatile organic compounds were detected by EPA Method 8260B.







diameter, circular pattern of randomly oriented, partially crushed, empty 55-gallon drums on their sides.

#### **2.2.1.2 Previous Investigation Results**

Using decision criteria outlined in the Work Plan, the DBA was selected as an additional area of investigation based on the results of EE/CA site inspection activities. No information regarding previous investigations is available. It is not likely that the area has been investigated before 2000.

#### **2.2.1.3 EE/CA Field Investigation Results**

One test pit was initially advanced within the DBA. The first test pit was advanced to 10 feet bgs to investigate an anomaly in the center of the DBA identified by the geophysical investigation. No debris was encountered during excavation of DBATP01; however, one soil sample was collected from 1 foot bgs (DBATP01SO1.0) in this test pit. Analytical results indicated that DRO is present at 6,480 ppm at this location. Based on the analytical result from DBATP01, six additional test pits were excavated during the second phase of investigation to determine the extent of DRO contamination using ATH and heated headspace (HHS) measurements. ATH results are summarized below and are included on test pit logs in Appendix B.

#### **2.2.1.4 Field Screening Results**

Twenty-one soil-filled drums from the drum walls of the DBA were randomly field-screened. ATH results for the soil-filled drums were nondetect. No fuel odor was detected from the 21 drums screened.

Soil removed during test pit excavations was field-screened using ATH measurements. ATH measurements collected from DBATP01 ranged from 0.1 ppm to 1.0 ppm. No fuel odor was detected. ATH and HHS field measurements were collected from the six additional test pits (DBATP02 through DBATP07). All ATH readings were nondetect. Several HHS samples had elevated readings ranging from 0.0 ppm to 22.2 ppm. No fuel odor was detected in test pit samples. Refer to test pit logs in Appendix B for headspace results.

#### **2.2.1.5 Laboratory Analytical Results**

One surface sample (DBATP01SO1.0) was collected and analyzed for GRO, DRO, RRO, BTEX, and PAH. DRO was detected at a concentration of 6,480 ppm and RRO was detected at 4,970 ppm. Interpretation of DRO/RRO sample chromatograms indicates that the hydrocarbons observed in this sample are heavy residual oil products with no resolved individual peaks. Laboratory analytical results for the DBA soils are summarized in Table 2-2.

Table 2-2 Drum Bunker Area Soil Sample Analytical Results

Parameter	Test Pit Sample
	DBATP01
Location ID:	1-1.5
Depth (feet):	DBATP01SO1.0N1
Sample ID:	6/22/00
Sample Date:	
Sample QC Type:	1003316001
Laboratory ID(s):	
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>	
Gasoline Range Organics	2.63 U
Diesel Range Organics	6480
Residual Range Organics	4970
<b>BTEX [8021B] (µg/kg)</b>	
Benzene	13.1 U
Ethylbenzene	52.5 U
m,p-Xylene (Sum of Isomers)	52.5 U
o-Xylene	52.5 U
Toluene	52.5 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>	
Acenaphthene	1.6 U
Acenaphthylene	1.6 U
Anthracene	1.6 U
Benzo(a)anthracene	1.6 U
Benzo(a)pyrene	1.6 U
Benzo(b)fluoranthene	1.80
Benzo(g,h,i)perylene	1.6 U
Benzo(k)fluoranthene	1.6 U
Chrysene	1.83
Dibenzo(a,h)anthracene	1.6 U
Fluoranthene	1.6 U
Fluorene	1.6 U
Indeno(1,2,3-cd)pyrene	1.6 U
Naphthalene	1.6 U
Phenanthrene	1.6 U
Pyrene	1.6 U
<b>Physical Parameters</b>	
Total Solids (percent)	97.4

**Key:**

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

## **2.2.2 Large Foundation Area**

### **2.2.2.1 Physical Description**

The LFA is located east of 42<sup>nd</sup> Street. Figure 2-2 shows site features, test pit locations, and drilling locations. The area consists of a “T” shaped concrete pad. Floor tiles are evident on the edge of the concrete foundation. Additionally, on the west end of the foundation, a rectangular shaped area surrounded by drainage indentations on three sides apparently had been resurfaced with concrete sometime after construction. The purpose of the resurfaced pad is unknown. Several floor drains were also present throughout the pad. The floor drains are filled with soil and organic matter.

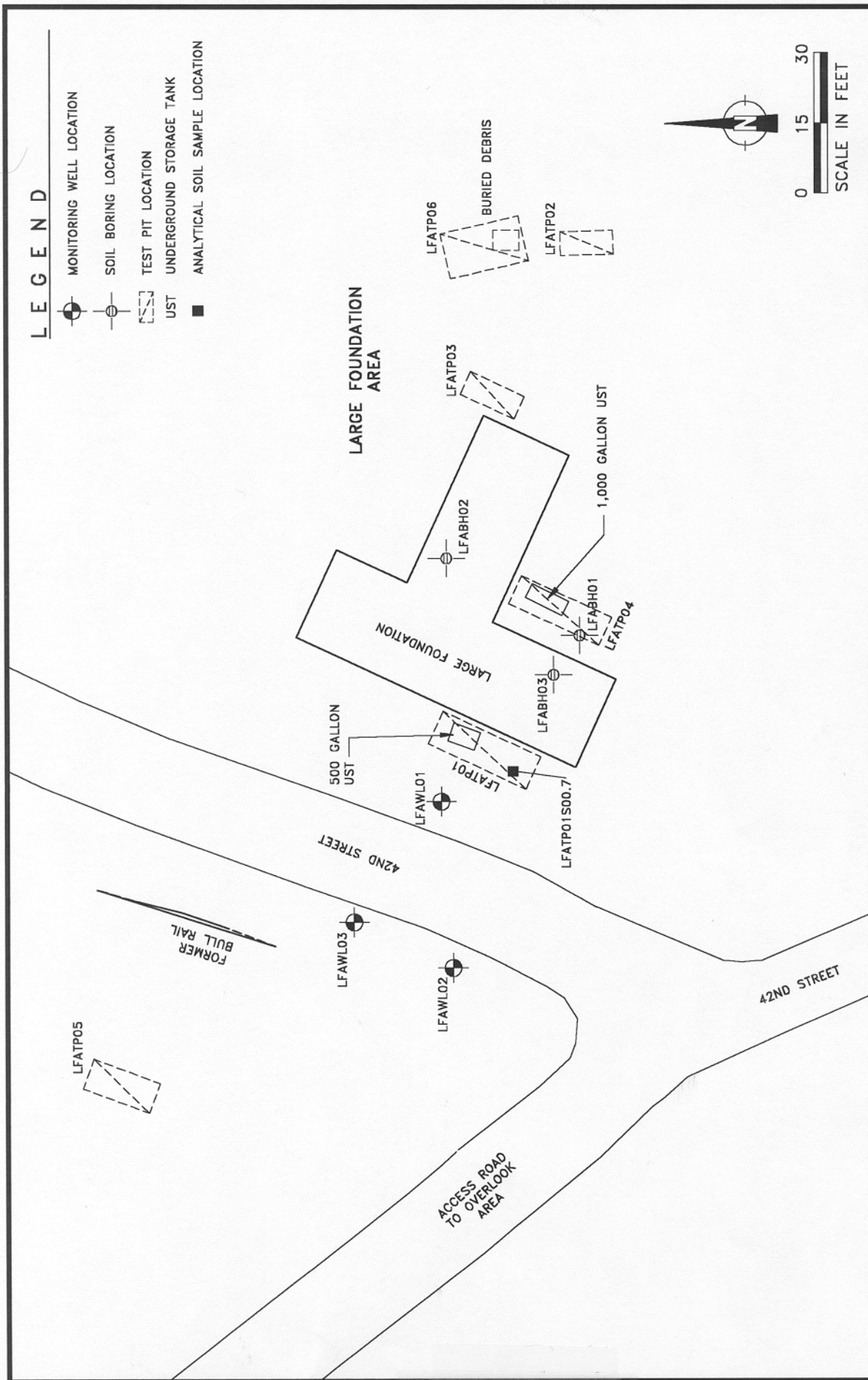
Within the concrete foundation, a 6-inch-diameter steel vertical pipe extends from 2 feet above ground surface to 2.5 feet bgs. The pipe is filled with debris at 2.5 feet bgs to presumably 9 feet bgs, where it terminates at a septic crib or wood-constructed void. The purpose of this pipe is unknown. The pipe apparently terminates in this void, which was encountered during drilling (LFABH02) immediately adjacent to the vertical pipe. The void was penetrated with a split-spoon sampler at 9 feet bgs. The bottom of the void is at 12 feet bgs. The lateral extent of the void is unknown as it is beneath the concrete foundation.

### **2.2.2.2 Previous Investigation Results**

During the LFI in 1997 (USAF 1999b), two hand borings were advanced to 4 feet bgs at areas of observed stressed vegetation (low brush growth) along the northern side of the concrete pad. There were no PID readings or observed staining to indicate the presence of contamination; therefore, no laboratory samples were collected.

LFI fieldwork was also conducted in 1998 and included the excavation of two test pits and the screening of eight soil samples for PCBs. TP-1 was excavated along the south side of the foundation to a depth of 3 feet bgs without exhibiting any PID readings or other evidence of contamination; therefore, no laboratory samples were collected. TP-2 was excavated along the northwest side of the foundation adjacent to a 3-inch diameter iron pipe found protruding through the concrete foundation. Another iron pipe was encountered at 4 feet bgs exiting the foundation and was removed. A slight petroleum odor was noted during the excavation of TP-2, and headspace results of 32 ppm and 18 ppm were recorded from 5 to 7 feet bgs. Laboratory analysis on a sample collected from TP-2 at the 6 to 7 foot depth revealed concentrations of 43 milligrams per kilogram (mg/kg) DRO and 15 mg/kg RRO. However, according to the laboratory sample report, the client sample ID for TP-2 indicates the sample was collected from the 4 to 5 foot interval.

According to the LFI, eight soil samples were collected from the 1 to 2 foot bgs interval (PCB-01 through PCB-08) and screened for PCBs with an immunoassay field test kit. However, the locations of only seven of the samples were illustrated in the LFI report. Soil samples from two of the eight sample locations (PCB-03 and PCB-06) were analyzed at the laboratory for



3 CES/CEVR  
SS83 EE/CA  
ELMENDORF AFB, ALASKA  
ENSR PROJECT #9000-230

FIGURE 2-2  
LARGE FOUNDATION AREA  
SOIL BORING AND TEST PIT  
SAMPLE LOCATIONS

DRAWING: LFATP  
C/SC: 1:1  
DATE: 01/19/01

DRAWN: SSR  
ZIP: 44/00  
CHECK: J.D.

confirmation. Because of the incomplete report figure, it is not known exactly where the PCB laboratory sample PCB-06 was collected. All field-screened samples and laboratory confirmation sample PCB-06 were recorded below the detection limit. The laboratory reported a PCB concentration of 45 micrograms per kilogram ( $\mu\text{g/kg}$ ) in laboratory confirmation sample PCB-03. Three additional soil samples for laboratory analysis were collected within 8 feet of PCB-03 (samples PCB-12, PCB-13, and PCB-14) and were reported below the laboratory detection limit. No sample contained petroleum hydrocarbons or PCBs above ADEC soil cleanup levels.

### **2.2.2.3 EE/CA Field Investigation Results**

Results of the geophysical investigation directed further test pit excavations that revealed two USTs. A 500-gallon capacity UST (Tank 1) was uncovered in LFATP01. Tank 1 is 6.2 feet long, 4.0 feet in diameter, and fabricated of single-walled steel. The tank contained a fuel/water mixture consisting of approximately 325 gallons of fuel and 150 gallons of water. A 0.15-foot diameter fill pipe extended from the tank to the northeast and terminated at the south side of the presumed location of the former building's man door. Copper feed lines and a vent pipe were present but were not connected to Tank 1; they were possibly disturbed while excavating LFATP01. The second UST (Tank 2) is located south of the LFA. The top of Tank 2 is at 1 to 1.5 feet bgs. Tank 2 is a 1,000-gallon steel UST measuring 12 feet long and 3.3 feet in diameter. Tank 2 contained a fuel/water mixture of approximately 25 gallons of fuel and 200 gallons of water. A 0.15-foot diameter fill or vent pipe extended from the edge of the foundation southwest to the UST. Copper feed lines and a vent pipe were present but were not connected to Tank 2, and were possibly disturbed while excavating LFATP04. The contents of both tanks were removed as describe in Section 2.1.15. At the end of the field investigation, the tanks were covered with Visqueen® and clean fill and were left in place for future closure.

Investigation into the discharge location for these floor drains was conducted during the EE/CA field program; however, the discharge location could not be definitely determined. Rebar in the concrete foundation interfered with geophysical results in this area. However, the LFI conducted in 1998 identified a 3-inch-diameter iron pipe protruding from the northwest corner of the concrete foundation at a depth of approximately 4 feet bgs. The pipe, which could have been a floor drain discharge point, was removed during the LFI (USAF 1999b). The geophysical survey (Appendix A) conducted during the EE/CA field program identified an anomaly leading from the northwest corner of the LFA toward the suspected disposal area located northwest of the BBA and SFA. The narrow, linear anomaly suggests piping buried at moderate depth (approximately 5 feet). The wood-constructed void described in Section 2.2.2.1 is another potential floor drain discharge point. During subsequent closure activities at the LFA pad (such as UST removal), it may be beneficial to trench along the north edge of the LFA foundation to determine whether a discharge pipe extends from this side of the building.

Six test pits were excavated around the LFA. As discussed above, LFATP01 and LFATP04 were excavated because the geophysical results indicated large buried metallic objects

resembling USTs or drum burial piles. LFATP02 was excavated to investigate a small wooden “foundation” consisting of plywood that was visible in historic aerial photographs. No other debris was encountered in LFATP02. LFATP05 and LFATP06 were excavated after preliminary geophysical results indicated the presence in the subsurface of small metallic objects. Small metallic and wood debris was excavated from both test pits. Buried debris included 2 millimeter gauge pieces of rusted steel mesh, 3-inch nails, rusted cans, 3-inch diameter pipe, 10 feet of 0.5-inch diameter conduit, three 4-foot-long wooden tent poles, a section of stove pipe, railroad tie, painted wood, and plywood. No debris was encountered during excavation of LFATP03.

Three soil borings and three monitoring wells were installed at the LFA. One well (LFAWL01) was installed south of Tank 1, as close to the source area as possible. LFAWL02 and LFAWL03 were placed downgradient of the LFA. Soil borings were installed at the LFA because further subsurface soil investigation was warranted based on observations made during test pit excavations and monitoring well installation.

#### **2.2.2.4 Field Screening Results**

ATH measurements were collected from soil around Tank 1 (LFATP01). A maximum ATH reading of 53.9 ppm was measured in soils from 2.0 feet bgs and exhibited a strong, sweet, fuel odor. A fuel odor was noted in soils closest to the Tank 2 fill hole in LFATP04, although ATH readings did not exceed 1.5 ppm. ATH measurements from soils screened from LFATP02, LFATP05, and LFATP06 were non-detect. No elevated ATH readings exceeding 0.5 ppm were measured in LFATP03. None of the soils screened from LFATP02, LFATP03, LFATP05, and LFATP06 exhibited a fuel odor.

A total of 23 PCB field screening surface soil samples were collected from the LFA. No PCBs were detected above field screening detection limits. PCB sample locations for the LFA are shown on Figure 2-3, and results for samples with analytical confirmation are provided in Table 2-3.

#### **2.2.2.5 Laboratory Analytical Results**

Fourteen primary subsurface soil samples were collected from test pits and soil borings and analyzed for GRO, BTEX, VOC, DRO, RRO, and PAH. VOCs were not detected in any of the samples analyzed. GRO was detected in two samples (LFAWH02SO10.0 and LFAWH03SO2.0) at concentrations of 3.49 mg/kg and 5.91 mg/kg respectively. Xylene, the only BTEX analyte detected, was found in only one sample, LFAWH03SO2.0 at a concentration of 74.0 µg/kg. DRO was detected in seven samples ranging in concentration from 27.3 mg/kg to 3,000 mg/kg. RRO was detected in five samples ranging from 26.4 mg/kg to 253 mg/kg. Seven PAH analytes were detected in four samples. PAH analytes detected include chrysene (ranging from 2.59 µg/kg to 11.9 µg/kg), benzo(b)fluoranthene (1.74 µg/kg), acenaphthene (8.85 µg/kg), fluorene (15.5 µg/kg), phenanthrene (7.71 µg/kg), and naphthalene (ranging from 9.18 µg/kg to 11.7 µg/kg). Interpretation of the DRO/RRO chromatographs indicates that the hydrocarbons



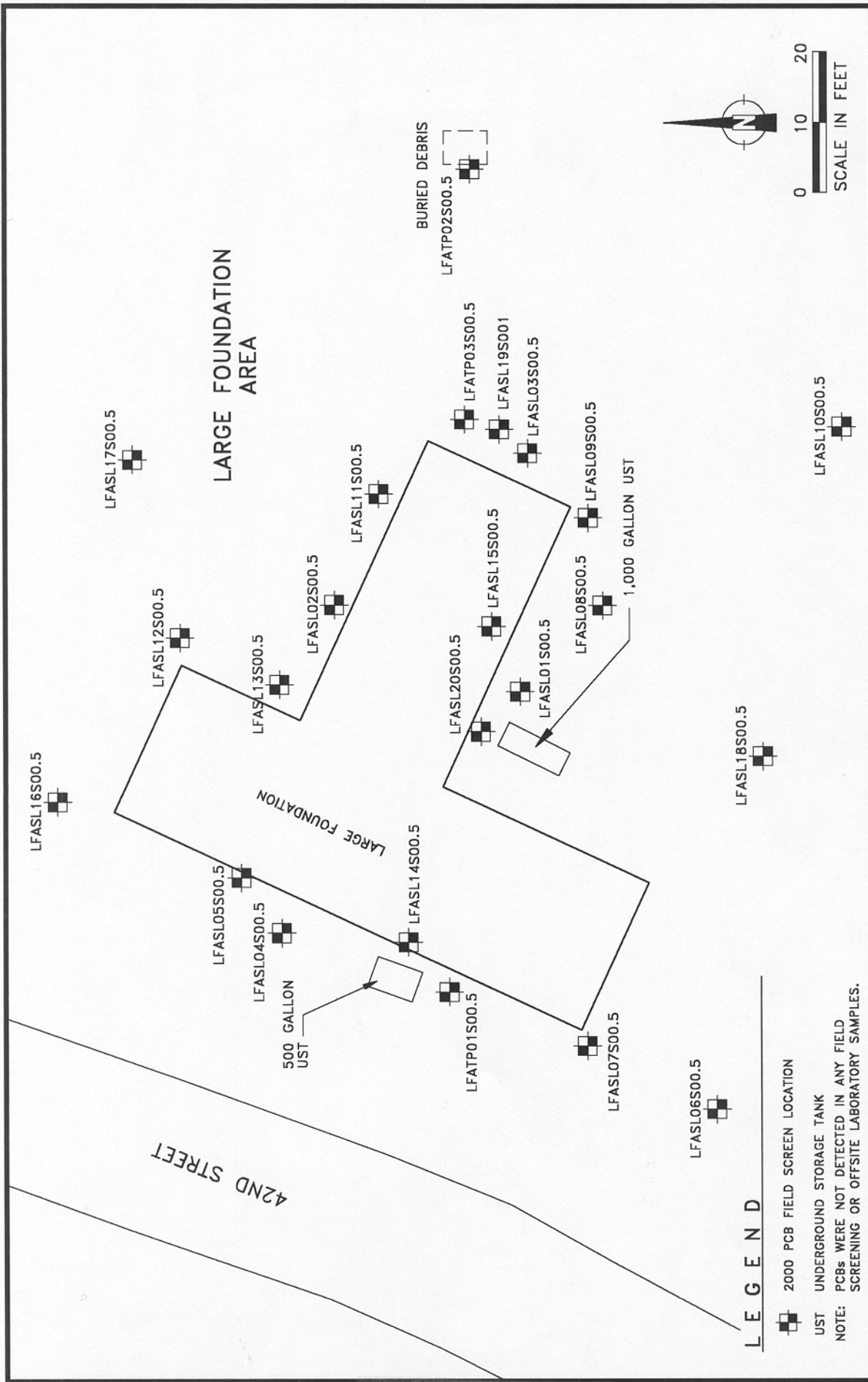


FIGURE 2-3  
 LARGE FOUNDATION AREA  
 PCB SAMPLE LOCATIONS

DRAWING: LFAPCB  
 C/SC: 1:1  
 DATE: 01/19/01

DRAWN: SSR  
 ZIP: 44/00  
 CHECK: J.D.

Table 2-3 Large Foundation Area Surface Soil Sample Analytical Results

Parameter	Surface Samples					
	LFASL07	LFASL08	LFASL09	LFASL19	LFASL20	
	0.5-0.7	0.5-0.7	0.5-0.7	0.5-0.7	1.0-1.5	
Location ID:	LFASL07SO0.5N1	LFASL08SO0.5N1	LFASL09SO0.5N1	LFASL19SO01N1	LFASL20SO1.0N1	
Depth (feet):	7/5/00	7/5/00	7/5/00	9/21/00	9/21/00	
Sample ID:	1003670001	1003670003	1003670005	1005694009	1005694010	
Sample Date:	7/5/00	7/5/00	7/5/00	9/21/00	9/21/00	
Sample QC Type:	Duplicate	Duplicate	Duplicate	Duplicate	Duplicate	
Laboratory ID(s):	1003670002	1003670004	1003670006	1005694008	1005694009	
<b>PCBs [8082] (µg/kg)</b>						
PCB-1016 (Aroclor 1016)	95.3 U	80.4 U	69.6 U	69.8 U	66.9 U	48.9 U
PCB-1221 (Aroclor 1221)	95.3 U	80.4 U	69.6 U	69.8 U	66.9 U	48.9 U
PCB-1232 (Aroclor 1232)	95.3 U	80.4 U	69.6 U	69.8 U	66.9 U	48.9 U
PCB-1242 (Aroclor 1242)	95.3 U	80.4 U	69.6 U	69.8 U	66.9 U	48.9 U
PCB-1248 (Aroclor 1248)	95.3 U	80.4 U	69.6 U	69.8 U	66.9 U	48.9 U
PCB-1254 (Aroclor 1254)	95.3 U	80.4 U	69.6 U	69.8 U	66.9 U	48.9 U
PCB-1260 (Aroclor 1260)	95.3 U	80.4 U	69.6 U	69.8 U	66.9 U	48.9 U
<b>PCB Field Screening Ensysis™ Soil Test Kit [4020] (ppm)</b>						
PCB-1254 (Aroclor 1254)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
<b>Physical Parameters</b>						
Total Solids (percent)	87.3	94.8	91.1	91.8	93.4	90.5

**Key:**

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.



observed in the LFA soil samples are weathered middle distillate products. Table 2-4 summarizes the LFA subsurface soil analytical results.

Five off-site laboratory surface soil samples were collected for PCB analysis. No PCBs were detected in any of the surface soil samples. Table 2-3 summarizes the off-site laboratory analytical results for PCBs at the LFA.

One groundwater sample was collected from each of the three LFA monitoring wells. Groundwater samples were analyzed for GRO, BTEX, VOCs, DRO, RRO, PAH, metals, and nitrate-nitrite. GRO, BTEX, DRO, RRO, and VOCs were not detected in any of the three groundwater samples analyzed. Naphthalene was detected in one well (LFAWL02) at a concentration of 0.0517 µg/L. Metals detected include arsenic, barium, chromium, lead, and mercury. Table 2-5 and Figure 2-4 summarize the LFA groundwater analytical results.

### **2.2.3 Motor Pool Area**

#### **2.2.3.1 Physical Description**

The MPA is located north of the LFA on the west side of 42<sup>nd</sup> Street (Figure 2-5). The MPA consists of an 80-foot by 36-foot concrete foundation. A mechanics pit exists at the west end of the foundation. The dimensions of the mechanics pit is 14 feet by 2.5 feet. Excavation of the mechanics pit revealed that the pit was constructed such that a concrete slab lined the bottom of the pit at 4.5 feet below the top edge of the foundation. Concrete blocks formed pit walls on top of the concrete slab from 3.5 to 4.5 feet below the top edge of the foundation. Approximately 2 feet of sidewall soil and collapsed sidewall concrete block rested on top of the concrete slab in the pit. Additionally debris consisting of oily rags, quart and gallon oil cans, used oil filters, muffler pipes, a shock absorber, one tire, one can labeled "*Berryman B-12 Chemtool*", and one can labeled "*Sears P.V.C. Smog Valve Cleaner*" were mixed with the sloughed soil. MPATP01 was excavated to a total depth of 10 feet below the top edge of the foundation. Soil remaining at the bottom of the excavation was oil-soaked.

#### **2.2.3.2 Previous Investigation Results**

During the LFI in 1997 (USAF 1999b), a single laboratory sample (HB-06) was collected at the 0 to 1 foot interval from within the pit using a hand auger and was analyzed for bulk petroleum hydrocarbons, BTEX, VOCs, SVOCs, and metals. Problems with sample matrix and soil media type resulted in certain QC deficiencies for the VOC analysis; that is, surrogate recoveries and MS/MSD analyte recoveries were outside QC limits. Similar sample matrix problems were encountered for SVOC analysis, resulting in elevated reporting limits. Poor MS recoveries were also noted for barium, chromium, and mercury in the sample. An analytical dilution was also necessary due to the high concentration of petroleum hydrocarbons present in the sample. Concentrations for DRO, RRO, benzene, methylene chloride, arsenic, and lead exceeded Method Two cleanup levels. The concentration reported for benzo(a)anthracene (3.8 mg/kg)

Table 2-4 Large Foundation Area Subsurface Soil Sample Analytical Results.

Location ID: Depth (feet): Sample ID: Sample Date: Sample QC Type: Laboratory ID(s):	Test Pit Sample	Boring Samples			
	LFATP01 0.7-2.7 LFATP01SO0.7N1 6/8/00 1003165001	7.5-9.5* LFABH01DC7.5 6/27/00 1003511001	LFABH01 10-11 LFABH01SO10.0N1 6/27/00 1003511002	LFABH01 10-11 LFABH01SO10.5N1 6/27/00 Duplicate 1003511003	LFABH03 17-19 LFABH03SO17.0N1 6/28/00 1003512001
Parameter					
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>					
Gasoline Range Organics	2.58 U	2.63 U	2.49 U	2.68 U	2.96 U
Diesel Range Organics	3000	226	550	678	28.4
Residual Range Organics	253	42.9	51.0	48.1	19.2 U
<b>BTEX [8021B] (µg/kg)</b>					
Benzene	12.9 U	13.2 U	12.5 U	13.4 U	14.8 U
Ethylbenzene	51.5 U	52.7 U	49.8 U	53.6 U	59.2 U
m,p-Xylene (Sum of Isomers)	51.5 U	52.7 U	49.8 U	53.6 U	59.2 U
o-Xylene	51.5 U	52.7 U	49.8 U	53.6 U	59.2 U
Toluene	51.5 U	52.7 U	49.8 U	53.6 U	59.2 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>					
Acenaphthene	160 U	3.3 U	3.5 U	1.7 U	8.85
Acenaphthylene	160 U	3.3 U	3.5 U	1.7 U	2.9 U
Anthracene	1.6 U	3.3 U	3.5 U	1.7 U	2.9 U
Benzo(a)anthracene	1.6 U	3.3 U	3.5 U	1.7 U	2.9 U
Benzo(a)pyrene	1.6 U	3.3 U	3.5 U	1.7 U	2.9 U
Benzo(b)fluoranthene	1.74	3.3 U	3.5 U	1.7 U	2.9 U
Benzo(g,h,i)perylene	1.6 U	3.3 U	3.5 U	1.7 U	2.9 U
Benzo(k)fluoranthene	1.6 U	3.3 U	3.5 U	1.7 U	2.9 U
Chrysene	1.9	3.3 U	3.5 U	1.7 U	2.9 U
Dibenzo(a,h)anthracene	1.6 U	3.3 U	3.5 U	1.7 U	2.9 U
Fluoranthene	1.6 U	3.3 U	3.5 U	1.7 U	2.9 U
Fluorene	160 U	3.3 U	3.5 U	1.7 U	15.5
Indeno(1,2,3-cd)pyrene	1.6 U	3.3 U	3.5 U	1.7 U	2.9 U
Naphthalene	160 U	3.3 U	3.5 U	1.7 U	5.66
Phenanthrene	1.6 U	3.3 U	3.5 U	1.7 U	7.71
Pyrene	1.6 U	3.3 U	3.5 U	1.7 U	2.9 U
<b>Volatile Organic Compounds [8260B] (mg/kg) #</b>					
No compounds detected	U	--	--	--	--
<b>Physical Parameters</b>					
Total Solids (percent)	94.7	95.8	94.7	94.2	85.1

**Key:**

-- = Analysis not performed on this sample.

\* Sample from drill cuttings.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

# No volatile organic compounds were detected; refer to Appendix H for full listing.

Table 2-4 Large Foundation Area Subsurface Soil Sample Analytical Results (cont'd)

Parameter	Boring Samples LFAWL01					
	10-12		15-17		17-19	
	Location ID: Depth (feet): Sample ID: Sample Date: Sample QC Type: Laboratory ID(s):	LFAWL01SO10.0N1 6/27/00 1003511005 Duplicate 1003511006	LFAWL01SO10.5N1 6/27/00 1003511007 Duplicate 1003511008	LFAWL01SO15.0N1 6/27/00 1003511009 Duplicate 1003511010	LFAWL01SO17.0N1 6/27/00 1003511011 Duplicate 1003511012	LFAWL01SO17.5N1 6/27/00 1003511013 Duplicate 1003511014
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>						
Gasoline Range Organics	2.61 U	2.65 U	3.19 U	3.14 U	3.07 U	2.82 U
Diesel Range Organics	9.93 U	9.07 U	405	340	27.3	21.7 U
Residual Range Organics	16.4 U	15.0 U	37.2 U	38.9 U	31.9 U	35.7 U
<b>BTEX [8021B] (µg/kg)</b>						
Benzene	13.1 U	13.2 U	16.0 U	15.7 U	15.3 U	14.1 U
Ethylbenzene	52.3 U	52.9 U	63.9 U	62.8 U	61.3 U	56.4 U
m,p-Xylene (Sum of Isomers)	52.3 U	52.9 U	63.9 U	62.8 U	61.3 U	56.4 U
o-Xylene	52.3 U	52.9 U	63.9 U	62.8 U	61.3 U	56.4 U
Toluene	52.3 U	52.9 U	63.9 U	62.8 U	61.3 U	56.4 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>						
Acenaphthene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Acenaphthylene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Anthracene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Benzo(a)anthracene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Benzo(a)pyrene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Benzo(b)fluoranthene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Benzo(g,h,i)perylene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Benzo(k)fluoranthene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Chrysene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Dibenzo(a,h)anthracene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Fluoranthene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Fluorene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Indeno(1,2,3-cd)pyrene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Naphthalene	1.6 U	1.6 U	9.18	11.7	4.0 U	2.8 U
Phenanthrene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
Pyrene	1.6 U	1.6 U	4.0 U	4.0 U	4.0 U	2.8 U
<b>Volatile Organic Compounds [8260B] (mg/kg) #</b>						
No compounds detected	--	--	--	--	--	--
<b>Physical Parameters</b>						
Total Solids (percent)	97.6	96.7	83.6	81.0	81.8	89.4

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

# No volatile organic compounds were detected; refer to Appendix H for full listing.

\* Sample from drill cuttings.

Table 2-4 Large Foundation Area Subsurface Soil Sample Analytical Results (cont'd)

Location ID: Depth (feet): Sample ID: Sample Date: Sample QC Type: Laboratory ID(s):	Boring Samples					
	LFAWL02		LFAWL03			
	5-7 LFAWH02SO5.0N1 6/28/00	10-12 LFAWH02SO10.0N1 6/28/00	17-19 LFAWH02SO17.0N1 6/28/00	2-3 LFAWH03SO2.0N1 6/28/00	11-12 LFAWH03SO11.0N1 6/28/00	17-19 LFAWH03SO17.0N1 6/28/00
Parameter	1003512003	1003512004	1003512005	1003512006	1003512007	1003512008
Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)						
Gasoline Range Organics	2.76 U	3.49	3.05 U	5.91	2.62 U	3.26 U
Diesel Range Organics	9.91 U	9.05 U	10.5 U	105	9.77 U	24.4 U
Residual Range Organics	16.4 U	26.4	17.3 U	171	16.1 U	40.2 U
BTEX [8021B] (µg/kg)						
Benzene	13.8 U	12.9 U	15.2 U	13.3 U	13.1 U	16.3 U
Ethylbenzene	55.1 U	51.6 U	61.0 U	53.2 U	52.4 U	65.3 U
m,p-Xylene (Sum of Isomers)	55.1 U	51.6 U	61.0 U	74.0	52.4 U	65.3 U
o-Xylene	55.1 U	51.6 U	61.0 U	53.2 U	52.4 U	65.3 U
Toluene	55.1 U	51.6 U	61.0 U	53.2 U	52.4 U	65.3 U
Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)						
Acenaphthene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Acenaphthylene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Anthracene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Benzo(a)anthracene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Benzo(a)pyrene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Benzo(b)fluoranthene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Benzo(g,h,i)perylene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Benzo(k)fluoranthene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Chrysene	2.4 U	2.59	3.9 U	52 U	2.5 U	5.6 U
Dibenzo(a,h)anthracene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Fluoranthene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Fluorene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Indeno(1,2,3-cd)pyrene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Naphthalene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Phenanthrene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Pyrene	2.4 U	2.5 U	3.9 U	52 U	2.5 U	5.6 U
Volatile Organic Compounds [8260B] (mg/kg) #						
No compounds detected	--	--	--	--	--	--
Physical Parameters						
Total Solids (percent)	97.5	98.0	83.0	95.5	96.7	77.7

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

\* Sample from drill cuttings.

# No volatile organic compounds were detected; refer to Appendix H for full listing.

Table 2-5 Large Foundation Area Groundwater Sample Analytical Results

Location ID:	<b>LFAWL01</b>	<b>LFAWL02</b>	<b>LFAWL03</b>
Sample ID:	LFAWL01WG05N1	LFAWL02WG03N1	LFAWL03WG04N1
Sample Date:	7/13/00	7/13/00	7/13/00
Sample QC Type:			
Laboratory ID(s):	1003844001	1003844002	1003844003
Parameter			
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (µg/L)</b>			
Gasoline Range Organics	90.0 U	90.0 U	90.0 U
Diesel Range Organics	297 U	297 U	300 U
Residual Range Organics	495 U	495 U	500 U
<b>BTEX [8021B] (µg/L)</b>			
Benzene	0.500 U	0.500 U	0.500 U
Ethylbenzene	2.00 U	2.00 U	2.00 U
m,p-Xylene (Sum of Isomers)	2.00 U	2.00 U	2.00 U
o-Xylene	2.00 U	2.00 U	2.00 U
Toluene	2.00 U	2.00 U	2.00 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/L)</b>			
Acenaphthene	0.051 U	0.050 U	0.051 U
Acenaphthylene	0.051 U	0.050 U	0.051 U
Anthracene	0.051 U	0.050 U	0.051 U
Benzo(a)anthracene	0.051 U	0.050 U	0.051 U
Benzo(a)pyrene	0.051 U	0.050 U	0.051 U
Benzo(b)fluoranthene	0.051 U	0.050 U	0.051 U
Benzo(g,h,i)perylene	0.051 U	0.050 U	0.051 U
Benzo(k)fluoranthene	0.051 U	0.050 U	0.051 U
Chrysene	0.051 U	0.050 U	0.051 U
Dibenzo(a,h)anthracene	0.051 U	0.050 U	0.051 U
Fluoranthene	0.051 U	0.050 U	0.051 U
Fluorene	0.051 U	0.050 U	0.051 U
Indeno(1,2,3-cd)pyrene	0.051 U	0.050 U	0.051 U
Naphthalene	0.051 U	0.0517	0.051 U
Phenanthrene	0.051 U	0.050 U	0.051 U
Pyrene	0.051 U	0.050 U	0.051 U
<b>Volatile Organic Compounds [8260B] (µg/L) *</b>			
No volatile organic compounds were detected.			
<b>Metals [6000/7000] (µg/L)</b>			
Arsenic	12.5	28.8	13.1
Barium	253	481	193
Cadmium	0.568 U	0.556 U	0.556 U
Chromium	52.4	136	52.8
Lead	12.7	30.1	12.6
Mercury	0.200 U	0.443	0.200 U
Selenium	227 U	5.56 U	5.56 U
Silver	1.14 U	1.11 U	1.11 U
<b>Geochemical Indicator</b>			
Nitrate-Nitrite (mg/L)	1.48	1.42	1.43

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

\* No volatile organic compounds were detected; refer to Appendix H for complete listing.

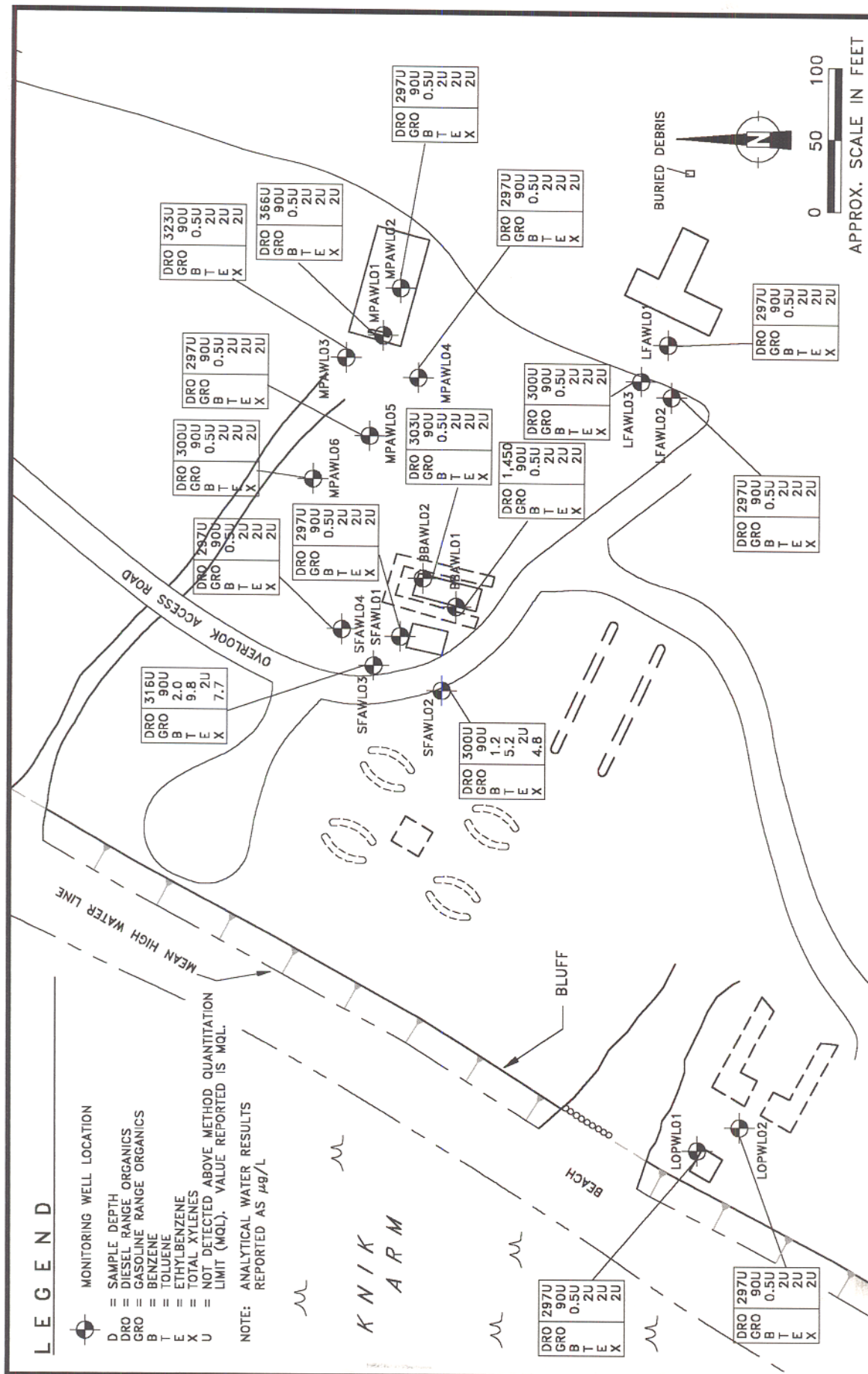
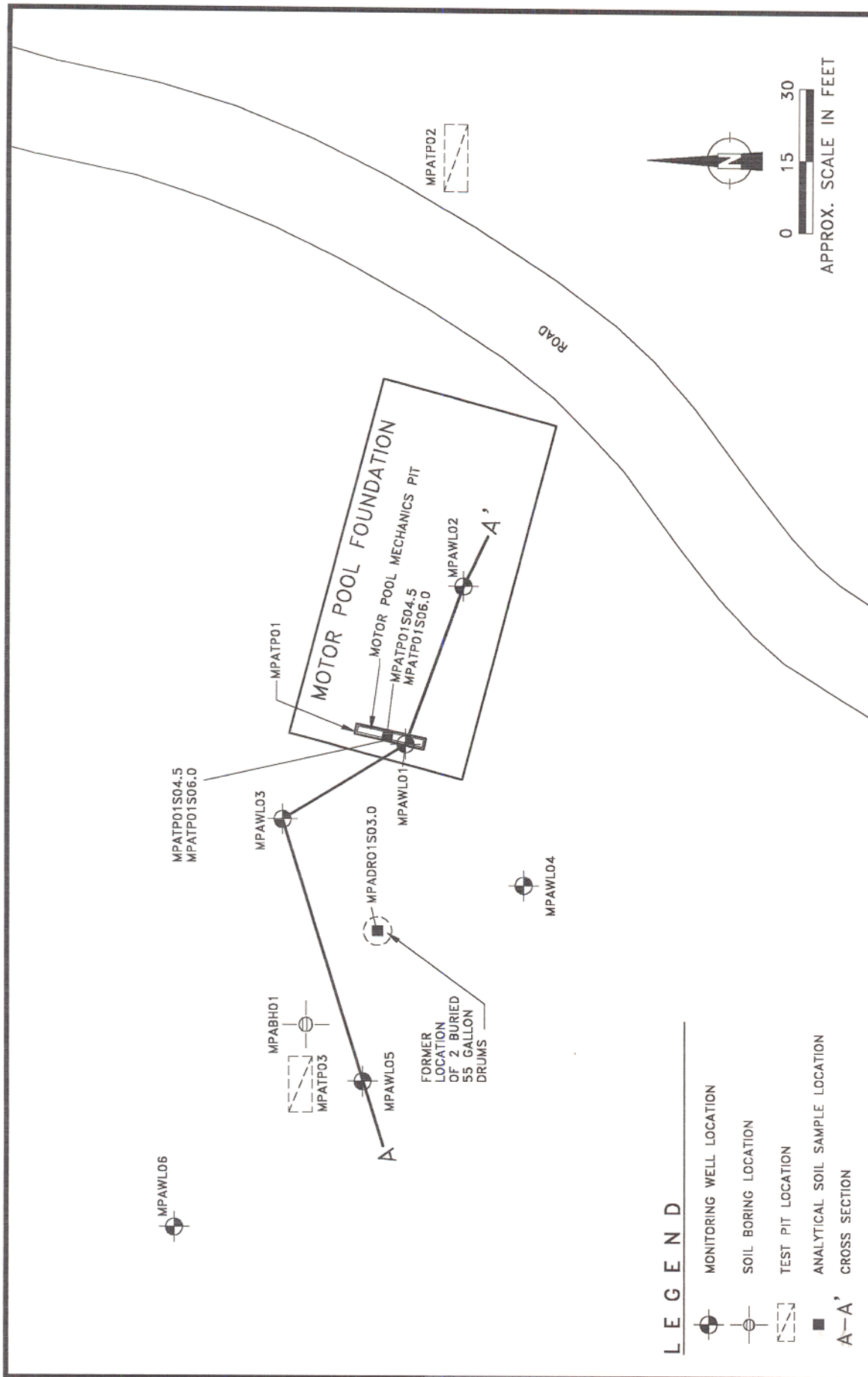


FIGURE 2-4  
SS83  
GROUNDWATER SAMPLE RESULTS

3 CES/CEVR  
SS83 EE/CA  
ELMENDORF AFB, ALASKA  
ENSR PROJECT #9000-230



3 CES/CEVR  
 SS83 EE/CA  
 ELMENDORF AFB, ALASKA  
 ENSR PROJECT #9000-230

FIGURE 2-5  
 MOTOR POOL AREA  
 SOIL BORING AND TEST PIT  
 SAMPLE LOCATIONS

DRAWING: MPATP  
 C/SC: 1:1  
 DATE: 01/19/01

DRAWN: SSR  
 ZIP: 44/00  
 CHECK: J.D.



was estimated due to laboratory dilution and sample matrix problems, but was near the soil cleanup level of 6 mg/kg.

Several discarded oil cans were located approximately 10 feet north of the concrete pad during the 1997 LFI activities. A hand-augered boring was completed in this area to a depth of 3 feet bgs, and a soil sample was screened for organic vapors, but there were no readings above the detection limit of the PID. There was no visual evidence of contamination; therefore, no laboratory samples were collected.

LFI activities continued in 1998 and included the excavation of two test pits in an effort to determine the extent of the contamination from the pit area. TP-5 was completed to a depth of 11 feet bgs approximately 3 feet west of the motor pool pit, and TP-6 was completed approximately 4 feet north of the motor pool pit and to a depth of 11 feet bgs. There were no organic vapors detected with the PID and no visual evidence of contamination in either test pit; therefore, no laboratory samples were collected.

### **2.2.3.3 EE/CA Field Investigation Results**

Three test pits were excavated at the MPA. The first test pit was excavated in the mechanics pit (MPATP01). The total depth of MPATP01 was excavated to 10 feet bgs. Soil remaining at 10 feet bgs was oil-soaked. MPATP02 was excavated east of 42<sup>nd</sup> Street to confirm the presence of metallic debris identified during the geophysical survey. A vehicle running board and fender were encountered at 2 feet bgs in MPATP02. Two buried 55-gallon drums were encountered while clearing brush for the geophysical survey. The drums were located approximately 30 feet west of the MPA. MPATP03 was excavated at this location to remove the buried drums. The first drum contained water. The second drum was corroded on the bottom and was resting on a rubber mat. This drum was three-quarters filled with oil laden soil and one-quarter filled with oily rags. Soil excavated from the test pits was managed as described in Section 2.1.15.

Six monitoring wells and one soil boring were installed at the MPA. One well (MPAWL01) was installed in the mechanics pit to delineate the vertical extent of contamination associated with the pit. MPAWL02 was installed upgradient of the mechanics pit. The remaining four monitoring wells were installed downgradient of the MPA. One soil boring was installed (MPABH01) because groundwater was not encountered at the total depth of the soil boring.

### **2.2.3.4 Field Screening Results**

ATH measurements were collected from the MPA test pit soils and soil borings. The highest ATH measurement recorded in the mechanics pit in MPATP01 was 15.8 ppm from slough in the pit. ATH measurements for MPATP02 varied between 0 ppm to 4.7 ppm; however, no fuel odor was detected. An ATH measurement from soil in the drum excavated from MPATP03 had an elevated reading of 73.8 ppm accompanied by a strong petroleum odor. ATH readings collected during drilling activities ranged from 0 ppm to 33.5 ppm. No fuel odor was observed in soils encountered during soil boring and monitoring well installation.



Three PCB field-screening samples were collected from the mechanics pit during excavation activities. PCBs were not measured above field screening detection limits.

### 2.2.3.5 Laboratory Analytical Results

One soil sample was collected from soil and debris that filled a 55-gallon drum excavated from MPATP03. This debris sample was analyzed for GRO, BTEX, DRO, RRO, metals, and PAHs. Analytes and concentrations detected in the debris sample include GRO (103 mg/kg), DRO (6,480 mg/kg), RRO (4,850 mg/kg), total BTEX (4,884 µg/kg), naphthalene (142 µg/kg), phenanthrene (327 µg/kg), arsenic (2.00 mg/kg), barium (65.8 mg/kg), cadmium (1.08 mg/kg), chromium (36.7 mg/kg), lead (170 mg/kg), and mercury (0.0492 mg/kg). Interpretation of the DRO/RRO chromatograph indicates that the hydrocarbons observed in the debris sample from the MPA are heavy residual oil products. Table 2-6 summarizes the analytical results from the MPA debris sample.

Twenty-five soil samples were collected from the MPA test pits and soil borings. MPA soil samples were analyzed for GRO, BTEX, VOC, DRO, RRO, metals, PAH, SVOC, and TOC. Table 2-6 shows the analytical results for the MPA soils. Analytical results indicate that DRO/RRO contamination decreased significantly with depth. DRO and RRO were detected at 1,070 mg/kg and 11,800 mg/kg in the deepest MPATP01 sample collected at 6.0 feet bgs, while DRO and RRO were not detected in any of three samples collected at depths from approximately 16.6 to 23.5 feet bgs at MPAWL01. GRO, DRO, benzene, ethylbenzene, and total xylenes were not detected in any of the soil boring soil samples. Toluene was detected in one subsurface sample (MPAWL01S022.0) at 66.0 mg/kg. RRO was detected in two subsurface soil samples at up to 27.3 mg/kg. Naphthalene and phenanthrene were the only PAH analytes detected. Naphthalene was detected in three soil boring samples ranging from 1.86 to 4.75 µg/kg. Phenanthrene was detected in four soil boring samples ranging from 1.86 to 4.63 µg/kg. Metals detected included arsenic, barium, cadmium, chromium, lead, mercury, and silver.

Two samples were collected from the test pit dug within the mechanics pit (MPATP01). The shallow sample MPATP01SO4.5 collected at 4.5 feet bgs had higher concentrations of chemicals of concern than the deeper sample MPATP01SO6.5. Analyte concentrations in the two samples collected from MPATP01 ranged from not detected to 18.1 mg/kg for GRO; 1,070 mg/kg DRO; 11,800 to 94,000 mg/kg RRO; total BTEX from nondetect to 2,397 mg/kg; 21,130 to 33,780 mg/kg TOC; and PAHs from nondetect to 2,330 mg/kg benzo(a)anthracene. Selenium was the only metal that was not detected in either MPATP01 soil sample. Interpretation of the DRO/RRO chromatographs indicates that the hydrocarbons observed in the MPA mechanics pit sample are heavy residual oil products. Table 2-6 summarizes the test pit analytical results for the MPA.

Table 2-6 Motor Pool Area Soil Sample Analytical Results (con't)

Location ID: Depth (feet): Sample ID: Sample Date: Sample QC Type: Laboratory ID(s):	MPAWL03			Boring Samples				MPAWL05	
	6-7	19-20	21-22	16-17	20-22	22-24	5-7	10-12	15-17
MPAWL03S06.0N1 6/20/00 1003220008	MPAWL03S06.0N1 6/20/00 1003220009	MPAWL03S019.0N1 6/20/00 1003220010	MPAWL03S021.0N1 6/20/00 1003220011	MPAWL03S020.0N1 6/20/00 1003220012	MPAWL03S022.0N1 6/20/00 1003220013	MPAWL03S05.0N1 6/21/00 1003315010	MPAWL03S010.0N1 6/21/00 1003315011	MPAWL03S010.0N1 6/21/00 Duplicate 1003315012	MPAWL03S015.0N1 6/21/00 1003315013
Parameter									
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>									
Gasoline Range Organics	2.68 U	3.03 U	2.94 U	2.72 U	2.93 U	3.10 U	2.56 U	2.55 U	2.73 U
Diesel Range Organics	5.11 U	11.7 U	10.5 U	10.5 U	16.2 U	17.1 U	10.1 U	9.66 U	9.89 U
Residual Range Organics	8.44 U	19.4 U	17.4 U	27.3 U	26.7 U	28.2 U	15.9 U	16.0 U	16.3 U
<b>BTEX [8021B] (µg/kg)</b>									
Benzene	13.4 U	15.2 U	14.7 U	13.6 U	14.6 U	15.5 U	12.8 U	12.7 U	13.7 U
Ethylbenzene	53.7 U	60.7 U	58.9 U	54.4 U	58.6 U	62.0 U	51.2 U	51.0 U	54.7 U
m,p-Xylene (Sum of Isomers)	53.7 U	60.7 U	58.9 U	54.4 U	58.6 U	62.0 U	51.2 U	51.0 U	54.7 U
o-Xylene	53.7 U	60.7 U	58.9 U	54.4 U	58.6 U	62.0 U	51.2 U	51.0 U	54.7 U
Toluene	53.7 U	60.7 U	58.9 U	54.4 U	58.6 U	62.0 U	51.2 U	51.0 U	54.7 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>									
Acenaphthene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Acenaphthylene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Anthracene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Benzo(a)anthracene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Benzo(a)pyrene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Benzo(b)fluoranthene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Benzo(g,h,i)perylene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Benzo(k)fluoranthene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Chrysene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Dibenz(a,h)anthracene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Fluoranthene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Fluorene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Indeno(1,2,3-cd)pyrene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Naphthalene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Phenanthrene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
Pyrene	1.6 U	1.8 U	1.8 U	1.7 U	2.8 U	2.7 U	1.7 U	1.6 U	1.7 U
<b>Volatile Organic Compounds [8260B] (mg/kg) *</b>									
Toluene	--	--	--	--	--	0.0217	--	--	--
<b>Metals [6000/7000] (mg/kg)</b>									
Arsenic	4.90	1.83	2.49	0.834	1.79	2.17	1.59	2.69	2.62
Barium	68.8	41.1	32.6	39.2	25.2	35.7	28.1	34.2	35.3
Cadmium	0.0535	0.0938	0.0524	0.105	0.0845	0.0813	0.0699	0.0772	0.0478
Chromium	36.7	35.7	33.2	28.9	33.0	42.0	33.9	45.6	19.7
Lead	6.67	7.45	5.24	11.3	6.15	6.07	6.58	6.89	4.03
Mercury	0.0485	0.145	0.0726	0.0384	0.0429	0.0609	0.0535	0.0671	0.0232
Selenium	4.14 U	0.268 U	0.282 U	0.201 U	0.254 U	0.278 U	0.257 U	0.246 U	0.249 U
Silver	0.0414 U	0.0536 U	0.0564 U	0.0580 U	0.0508 U	0.0557 U	0.0514 U	0.0492 U	0.0498 U
<b>Physical Parameters</b>									
Total Organic Carbon (mg/kg)	--	--	661 U	--	536 U	--	--	--	--
Total Solids (percent)	94.8	83.4	86.6	94.8	86.2	83.1	96.7	97.1	95.4

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

\* For brevity, only detected compounds listed here; refer to Appendix H for the full listing.



Table 2-6 Motor Pool Area Soil Sample Analytical Results

Location ID: Depth (feet): Sample ID: Sample Date: Sample QC Type: Laboratory ID(s): Parameter	Boring Samples									
	MPABH01 10-12		15-17		16.6-17.0		MPAWL01 20.4-21.0		MPAWL02 15-16	
	5-7 MPABH01S05.0N1 6/21/00 1003315006	MPABH01S010.0N1 6/21/00 Duplicate 1003315008	MPABH01S010.5N1 6/21/00 Duplicate 1003315009	MPABH01S015.0N1 6/21/00	MPAWL01S016.6N1 6/19/00 1003220002	MPAWL01S020.4N1 6/19/00 1003220003	MPAWL01S022.0N1 6/19/00 1003220004	MPAWL02S010.0N1 6/19/00 1003220005	MPAWL02S015.0N1 6/19/00 1003220006	MPAWL02S019.0N1 6/19/00 1003220007
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>										
Gasoline Range Organics	2.57 U	2.71 U	2.60 U	2.88 U	2.67 U	3.07 U	2.66 U	2.65 U	2.71 U	2.91 U
Diesel Range Organics	9.70 U	10.3 U	9.91 U	11.2 U	9.12 U	11.2 U	10.3 U	9.73 U	4.82 U	5.60 U
Residual Range Organics	16.0 U	17.0 U	16.4 U	18.5 U	15.1 U	18.5 U	17.0 U	16.1 U	7.95 U	13.4
<b>BTEX [8021B] (µg/kg)</b>										
Benzene	12.9 U	13.5 U	13.0 U	14.4 U	13.3 U	15.3 U	13.3 U	13.3 U	13.6 U	14.6 U
Ethylbenzene	51.4 U	54.1 U	51.9 U	57.6 U	53.4 U	61.3 U	53.2 U	53.0 U	54.2 U	58.2 U
m,p-Xylene (Sum of Isomers)	51.4 U	54.1 U	51.9 U	57.6 U	53.4 U	61.3 U	53.2 U	53.0 U	54.2 U	58.2 U
o-Xylene	51.4 U	54.1 U	51.9 U	57.6 U	53.4 U	61.3 U	53.2 U	53.0 U	54.2 U	58.2 U
Toluene	51.4 U	54.1 U	51.9 U	57.6 U	53.4 U	61.3 U	66.0	53.0 U	54.2 U	58.2 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>										
Acenaphthene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Acenaphthylene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Anthracene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Benzo(a)anthracene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Benzo(a)pyrene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Benzo(b)fluoranthene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Benzo(g,h,i)perylene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Benzo(k)fluoranthene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Chrysene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Dibenz(a,h)anthracene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Fluoranthene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Fluorene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Indeno(1,2,3-cd)pyrene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Naphthalene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Phenanthrene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
Pyrene	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.8 U	1.8 U	1.6 U	1.7 U	1.8 U
<b>Volatiles Organic Compounds [8260B] (mg/kg) *</b>										
Toluene	--	--	--	--	--	0.016 U	--	--	--	--
<b>Metals [6000/7000] (mg/kg)</b>										
Arsenic	4.05	4.48	4.42	2.25	--	3.09	2.12	0.903	2.09	1.84
Barium	36.2	33.4	32.3	33.9	--	47.4	73.3	22.1	20.5	34.6
Cadmium	0.295	0.100	0.0996	0.106	--	0.118	0.134	0.0617	0.0743	0.0922
Chromium	31.0	32.0	34.2	37.8	--	39.3	47.1	51.2	31.3	36.7
Lead	5.27	7.84	6.00	6.64	--	8.55	14.7	5.79	6.27	8.05
Mercury	0.0733	0.0706	0.0548	0.275	--	0.0807	0.126	0.0316	0.0399	0.0637
Selenium	0.239 U	0.256 U	0.248 U	0.277 U	--	0.241 U	0.216 U	0.188 U	0.243 U	0.234 U
Silver	0.0479 U	0.0513 U	0.0679 U	0.0553 U	--	0.0681	0.0696	0.0376 U	0.0486 U	0.0689
<b>Physical Parameters</b>										
Total Organic Carbon (mg/kg)	--	--	--	--	--	--	--	--	--	--
Total Solids (percent)	96.6	96.2	95.9	87.1	94.8	83.0	89.7	97.0	94.8	87.4

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

\* For brevity, only detected compounds listed here; refer to Appendix H for the full listing.



Table 2-6 Motor Pool Area Soil Sample Analytical Results (cont')

Parameter	Location ID:		Boring Samples					Test Pit Samples		Debris Sample
	Depth (feet): Sample ID: Sample Date: Sample QC Type: Laboratory ID(s):	MPAWL06S05.0N1 6/29/00 1003586005	MPAWL06		MPATP01		MPATP01S06.0N1 6/14/00 1002985005			
			5-7	10-12	12-14	15-17		17-19		
Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)										
Gasoline Range Organics	2.64 U	2.63 U	2.69 U	2.94 U	3.05 U	--	18.1	2.66 U	103	
Diesel Range Organics	15.6 U	14.1 U	15.5 U	15.5 U	22.8 U	--	2060 U	1070	6480	
Residual Range Organics	25.7 U	23.3 U	25.6 U	25.6 U	37.6 U	--	94000	11800	4850	
BTEX [8021B] (µg/kg)										
Benzene	13.2 U	13.1 U	13.4 U	14.7 U	15.2 U	--	68.1	13.3 U	141	
Ethylbenzene	52.9 U	52.5 U	53.7 U	58.7 U	60.9 U	--	233	53.2 U	787	
m,p-Xylene (Sum of Isomers)	52.9 U	52.5 U	53.7 U	58.7 U	60.9 U	--	844	53.2 U	1680	
o-Xylene	52.9 U	52.5 U	53.7 U	58.7 U	60.9 U	--	682	53.2 U	1290	
Toluene	52.9 U	52.5 U	53.7 U	58.7 U	60.9 U	--	570	53.2 U	986	
Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)										
Acenaphthene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	350 U	26 U	38 U	
Acenaphthylene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	350 U	26 U	38 U	
Anthracene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	698	26 U	38 U	
Benzo(a)anthracene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	2330	26 U	38 U	
Benzo(a)pyrene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	1110	26 U	38 U	
Benzo(b)fluoranthene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	1260	26 U	38 U	
Benzo(g,h,i)perylene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	2740	26 U	38 U	
Benzo(k)fluoranthene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	468	26 U	38 U	
Chrysene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	1740	26 U	38 U	
Dibenzo(a,h)anthracene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	350 U	26 U	38 U	
Fluoranthene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	1420	26 U	38 U	
Fluorene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	352	26 U	38 U	
Indeno(1,2,3-cd)pyrene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	598	26 U	38 U	
Naphthalene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	1820	26 U	142	
Phenanthrene	1.6 U	1.5 U	1.6 U	1.86	4.1 U	--	1600	26 U	327	
Pyrene	1.6 U	1.5 U	1.6 U	1.7 U	4.1 U	--	3660	26 U	38 U	
Volatile Organic Compounds [8260B] (mg/kg) *										
Toluene	--	--	--	--	--	--	--	--	--	
Metals [6000/7000] (mg/kg)										
Arsenic	12.0	1.86	1.85	2.32	2.68	2.63	8.17	6.51	2.00	
Barium	257	32.4	29.0	42.5	40.1	44.2	601	71.1	65.8	
Cadmium	0.309	0.0484	0.0598	0.0870	0.109	0.0854	3.11	0.409	1.08	
Chromium	25.0	17.0	30.4	33.3	34.3	30.5	89.7	17.8	36.7	
Lead	6.26	4.21	6.28	6.19	5.99	4.96	7350	257	170	
Mercury	0.155	0.248	0.0605	0.0775	0.0804	0.0736	0.0939	0.0349	0.0492	
Selenium	0.201 U	0.242 U	0.251 U	0.242 U	0.285 U	0.276 U	0.285 U	0.259 U	0.271 U	
Silver	0.0518	0.0484 U	0.0502 U	0.0483 U	0.0650	0.0551 U	0.0911	0.0518 U	0.0542 U	
Physical Parameters										
Total Organic Carbon (mg/kg)	--	--	--	--	--	--	33780	21130	--	
Total Solids (percent)	95.9	96.8	94.6	85.5	83.7	80.7	87.5	94.5	84.9	

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

\* For brevity, only detected compounds listed here; refer to Appendix H for the full listing.

One groundwater sample was collected from each of the six MPA monitoring wells. Table 2-7 and Figure 2-4 summarize the MPA groundwater sample analytical results. Groundwater samples were analyzed for GRO, BTEX, VOC, DRO, RRO, metals, PAH, and nitrate-nitrite. No GRO, BTEX, VOCs, DRO, or RRO were detected in any of the six MPA wells. Naphthalene was detected in one groundwater sample collected from MPAWL03 at a concentration of 0.0531 µg/L. No other PAH analytes were detected. Metals detected included arsenic, barium, cadmium, chromium, lead, and mercury.

Figure 2-6 shows a cross-sectional view of the MPA illustrating contaminant concentrations and the DRO plume in soil.

The high concentrations of inorganic constituents detected during this investigation most likely indicate that materials containing heavy metals (such as engine oil or automotive batteries) may have been spilled during operations at the motor pool.

## **2.2.4 Suspected Landfill Area**

### **2.2.4.1 Physical Description**

The LND is located northwest of the MPA and is situated between the bluff and Overlook Road (Figure 2-7). This area is estimated to be approximately 1.25 acres in size. The area is relatively flat-lying and is covered by grass and brush. Two lower-lying small ravines trend east to west and terminate at the bluff edge. The southern-most ravine appears to be an engineered (man-made) trench that trends from the southwest end of the MPA westward to the edge of the bluff, where it widens from a 2-foot wide trench to a 20-foot wide ravine and intercepts the top edge of the bluff. The northern-most ravine is approximately 80 feet long by 30 feet wide. Several groundwater seeps are exposed along the bluff beneath the landfill.

### **2.2.4.2 EE/CA Field Investigation Results**

A preliminary geophysical survey was conducted over this area, initially to determine whether there were any buried features that warranted further investigation. The survey was able to define the lateral limits of what appeared to be two trenches containing metallic debris (Appendix A). The western edge of the trenches was not delineated because trees prevented clear access for the survey team; however, one buried drum was observed eroding out of the bluff (west of LNDTP06) during the SS83 field investigation. Geophysical survey results indicated that a significant amount of metal debris was buried from near surface to 12 feet bgs. Based on the preliminary geophysical results, six test pits were excavated to characterize the debris buried in the LND.

A low-resolution magnetic survey was conducted over three potential landfill areas north of the main investigation area. These three areas were at the Overlook Area, the suspected disposal area east of the MPA, and along an area within the northwest corner of the site (Figure 2-7). Reconnaissance level geophysical survey results for these areas are presented in Appendix A.

Table 2-7 Motor Pool Area Groundwater Sample Analytical Results

Location ID: Sample ID: Sample Date: Sample QC Type: Laboratory ID(s):	MPAWL01	MPAWL02	MPAWL03	MPAWL04	MPAWL05	MPAWL06
	MPAWL01WG14N1	MPAWL02WG06N1	MPAWL03WG08N1	MPAWL04WG07N1	MPAWL05WG09N1	MPAWL06WG10N1
	7/14/00	7/13/00	7/13/00	7/13/00	7/13/00	7/13/00
	1003866006	1003844007	1003844008	1003844009	1003844010	1003844011
Parameter						
Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (µg/L)						
Gasoline Range Organics	90.0 U	90.0 U	90.0 U	90.0 U	90.0 U	90.0 U
Diesel Range Organics	366 U	297 U	323 U	297 U	297 U	300 U
Residual Range Organics	610 U	495 U	538 U	495 U	495 U	500 U
BTEX [8021B] (µg/L)						
Benzene	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U
Ethylbenzene	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
m,p-Xylene (Sum of Isomers)	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
o-Xylene	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
Toluene	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/L)						
Acenaphthene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Acenaphthylene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Anthracene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Benzo(a)anthracene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Benzo(a)pyrene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Benzo(b)fluoranthene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Benzo(g,h,i)perylene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Benzo(k)fluoranthene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Chrysene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Dibenzo(a,h)anthracene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Fluoranthene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Fluorene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Indeno(1,2,3-cd)pyrene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Naphthalene	0.050 U	0.0531	0.050 U	0.052 U	0.050 U	0.056 U
Phenanthrene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Pyrene	0.050 U	0.053 U	0.050 U	0.052 U	0.050 U	0.056 U
Volatile Organic Compounds [8260B] (µg/L) *						
No volatile organic compounds were detected.						
Metals [6000/7000] (µg/L)						
Arsenic	5.56 U	5.56 U	45.1	20.6	10.7	8.33
Barium	183	237	649	292	143	435
Cadmium	1.47	0.556 U	0.567	0.556 U	0.556 U	0.556 U
Chromium	5.56 U	24.4	126	68.6	27.8	62.4
Lead	5.56 U	6.22	42.9	22.2	7.22	14.4
Mercury	0.200 U	0.200 U	0.555	0.246	0.200 U	0.200 U
Selenium	5.56 U	5.56 U	5.56 U	5.56 U	5.56 U	5.56 U
Silver	1.11 U	1.11 U	1.11 U	1.11 U	1.11 U	1.11 U
Geochemical Indicator (mg/L)						
Nitrate-Nitrite	1.49	1.42	1.53	1.83	1.76	1.90

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

\* No volatile organic compounds were detected; refer to Appendix H for complete listing.



 MONITORING WELL LOCATION MONITORING WELL LOCATION

GROUNDWATER  
FLOW DIRECTION

[illegible]

WATER TABLE

== GASOLINE RANGE ORGANICS (mg/kg)  
 == DIESEL RANGE ORGANICS (mg/kg)  
 == RESIDUAL RANGE ORGANICS (mg/kg)  
 == BENZENE (µg/kg)  
 == TOLUENE (µg/kg)  
 == ETHYLBENZENE (µg/kg)  
 == TOTAL XYLENES (µg/kg)  
 == ARSENIC (mg/kg)  
 == CHROMIUM (mg/kg)  
 == LEAD (mg/kg)  
 == PHOTO IONIZING DETECTOR RESULT (PPM)  
 == ANALYTE NOT DETECTED  
 == ANALYTES NOT DETECTED, REFER TO TABLES  
 == FOR REPORTING LIMITS

CLEAN, STILL

ESTIMATED AREA OF CONTAMINATION

BOOTH EGGER COME CLAY

**NAPTOWNE ADVANCE OUTWASH  
DEPOSIT INTERBEDDED SILTY SAND  
AND GRAVEL**



0 10 20

HORIZONTAL SCALE IN FEET  
VERTICAL EXAGGERATION = 4X

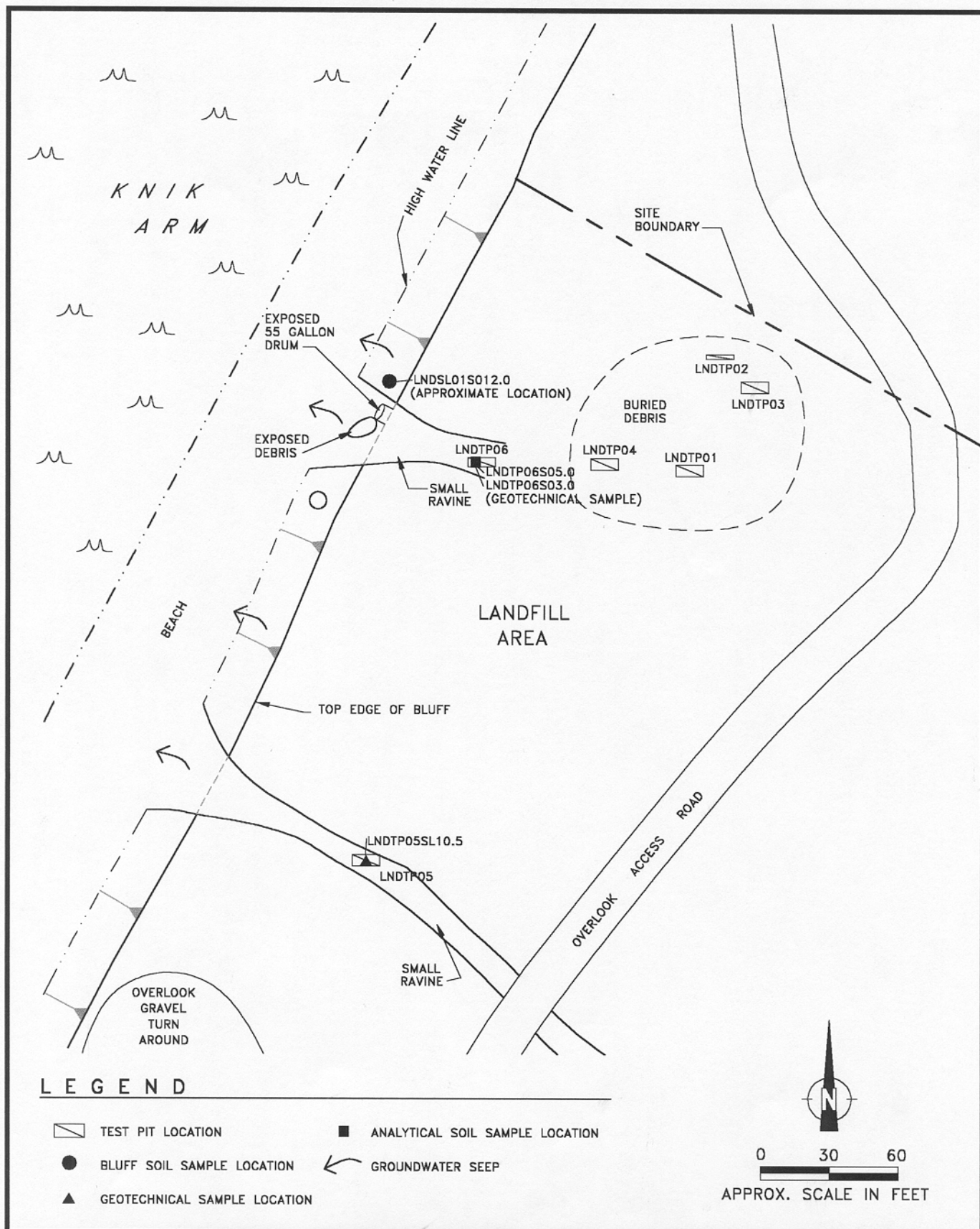
**SOURCE:**

3 CES/CEVR  
SS83 EE/CA  
EIMENDORE AFB. AU

FIGURE 2-6  
MOTOR POOL AREA,  
CROSS SECTION A-A,  
AND ANALYTICAL RESULTS

DATE:	05/11/01	DRAWN BY:	SSR	SCALE:	AS SHOWN	DRAWING:	MPACS
C/SC:	ZIP:	PM:	J. DONLEY	CHECKED:	J. DONLEY	PROJECT:	9500-230-600





DRAWING: LND

DRAWN: SSR

C/SC: 1:1PS

ZIP: 44/00

DATE: 01/19/00

CHECK: J.D.

FIGURE 2-7  
LANDFILL AREA  
TEST PIT AND BLUFF  
SAMPLE LOCATIONS

3 CES/CEVR  
SS83 EE/CA  
ELMENDORF AFB, ALASKA  
ENSR PROJECT #9000-230



These survey results suggest that only one area (the LND) likely contains any significant amounts of buried metal. This burial site is approximately 60 feet wide, has an east-west trend, and appears to be consistent with probable landfill trenches. The survey did not delineate the eastern or western limits of the suspected landfill. Metal within the area appears to include items near the surface down to 12 feet bgs. The survey also identified three isolated anomalies approximately 150 feet to the north. The anomalies were interpreted as representing scrap metal just below ground surface.

To confirm findings of the geophysical survey, test pits LNDTP01 through LNDTP04 were excavated within the area exhibiting the highest concentration of metallic debris based on the geophysical survey results. Test pit excavations ranged from 5 feet to 10 feet bgs. Debris was encountered in all test pits except LNDTP02. Debris in LNDTP01, LNDTP03, and LNDTP04 included approximately 10 55-gallon drums, 2 metal culverts, metal pipes, sheet metal, and canvas tarps. In the vicinity of the geophysical anomaly, 55-gallon drums and landing mats are exposed at the surface.

Test pit LNDTP06 was excavated in the center of the northernmost ravine; approximately twenty 55-gallon drums were encountered in this test pit. A thin, discontinuous white layer was also encountered in LNDTP06 at a depth of 1.5 feet bgs. This material was not tested and it is not known what the white material is. However, it may be of a biogenic origin (e.g., a fungus) based on 1) the presence of decaying debris (such as timbers and tarps) in the test pit, 2) the observation of a "moldy" odor in the pit, 3) the shallow location of the white layer, and 4) the uneven, discontinuous stratigraphy of the white layer. Field observations do not suggest that the white layer is characteristic of an asbestos-containing material. LNDTP06 was excavated to 5 feet bgs, where drums were evident buried beneath the total depth of the excavation. The drums in LNDTP06 were not sampled, as they generally appeared to be empty and crushed demolition debris. LNDTP05 was excavated in the southern-most ravine to characterize debris that was observed at the surface. No buried debris was encountered in LNDTP05.

Soils exposed in the bluff adjacent to the LND indicate that in general the advance outwash deposit sediments along the bluff are undisturbed. The advance outwash deposit in this area is composed of interbedded sand and gravel and is overlain by 2 feet to 3 feet of gray, laminated silt. In the vicinity of the northern-most ravine, the 2-foot to 3-foot-thick silt layer is nonexistent because of earth-moving activities. One 55-gallon drum is exposed in the bluff, 70 feet west of LNDTP06, beneath an organic mat overhang at 3 feet bgs. Additional debris encountered at this location included decaying wood timbers, rubber straps, and some small metal rods. Three groundwater seeps are also present along the bluff beneath the northern-most ravine. It was noted that tidal action appears to be eroding the bluff material and may have begun exposing portions of the buried material. The western edge of the geophysical survey grid at the landfill area is approximately 50 feet from the edge of the bluff. Based on the magnitude of the anomalies measured at the edge of the grid, buried debris probably extends at least another 20 feet toward the bluff. Thus, the current western edge of the landfill trench(es) could be estimated at approximately 20 feet or less from the edge of the bluff. With an estimated bluff regression of

2 feet per year (refer to Section 1.5.4), significant exposure of the landfill trench could be expected within 10 years. Note that presumably isolated debris is currently exposed and visible in the bluff (e.g., a drum, scraps of rubber hose, wood timbers, and miscellaneous metal rods).

#### **2.2.4.3 Field Screening Results**

ATH measurements were collected from LND test pits. ATH measurements ranged from non detect to 3.5 ppm. LNDTP06 had the highest ATH readings and also had the most debris, including twenty 55-gallon drums. At LNDTP06, the readings increased from 1.6 ppm at 2 feet bgs to 3.5 ppm at 5 feet bgs. No petroleum odor was detected in any LND test pits.

#### **2.2.4.4 Laboratory Analytical Results**

One soil sample (LNDTP06SO5.0) was collected from the LND test pit and analyzed for GRO, BTEX, DRO, and RRO. GRO, BTEX, and DRO were non-detect. RRO was detected at 48.3 mg/kg. Table 2-8 shows the landfill test pit sample soil results.

One soil sample was collected from the bluff face approximately 15 feet north of the exposed drum along the bluff. The purpose of the bluff face soil sample at this location was to assess whether the groundwater seep directly downgradient of the highest concentration of buried drums in the landfill is being impacted by buried landfill debris. The bluff face soil sample (LNDSL01SO12.0) was analyzed for GRO, BTEX, DRO, and RRO; results are shown on Table 2-8. Analytical results indicate that the surface soil on the bluff face is being impacted by DRO (237 mg/kg) and RRO (63.4 mg/kg). Interpretation of the DRO/RRO chromatograph indicates that the hydrocarbons observed in the bluff face soil sample are weathered middle distillate products.

### **2.2.5 Small Foundation Area**

#### **2.2.5.1 Physical Description**

The SFA consists of a 17 foot by 24 foot concrete pad located west of the BBA and southeast of the overlook turn around. The SFA concrete pad is a flat slab that is slightly dipping to the north. A step located in the center along the south edge of the concrete slab suggests the location of a former doorway. Figure 2-8 shows the SFA and its site features.

#### **2.2.5.2 Previous Investigation Results**

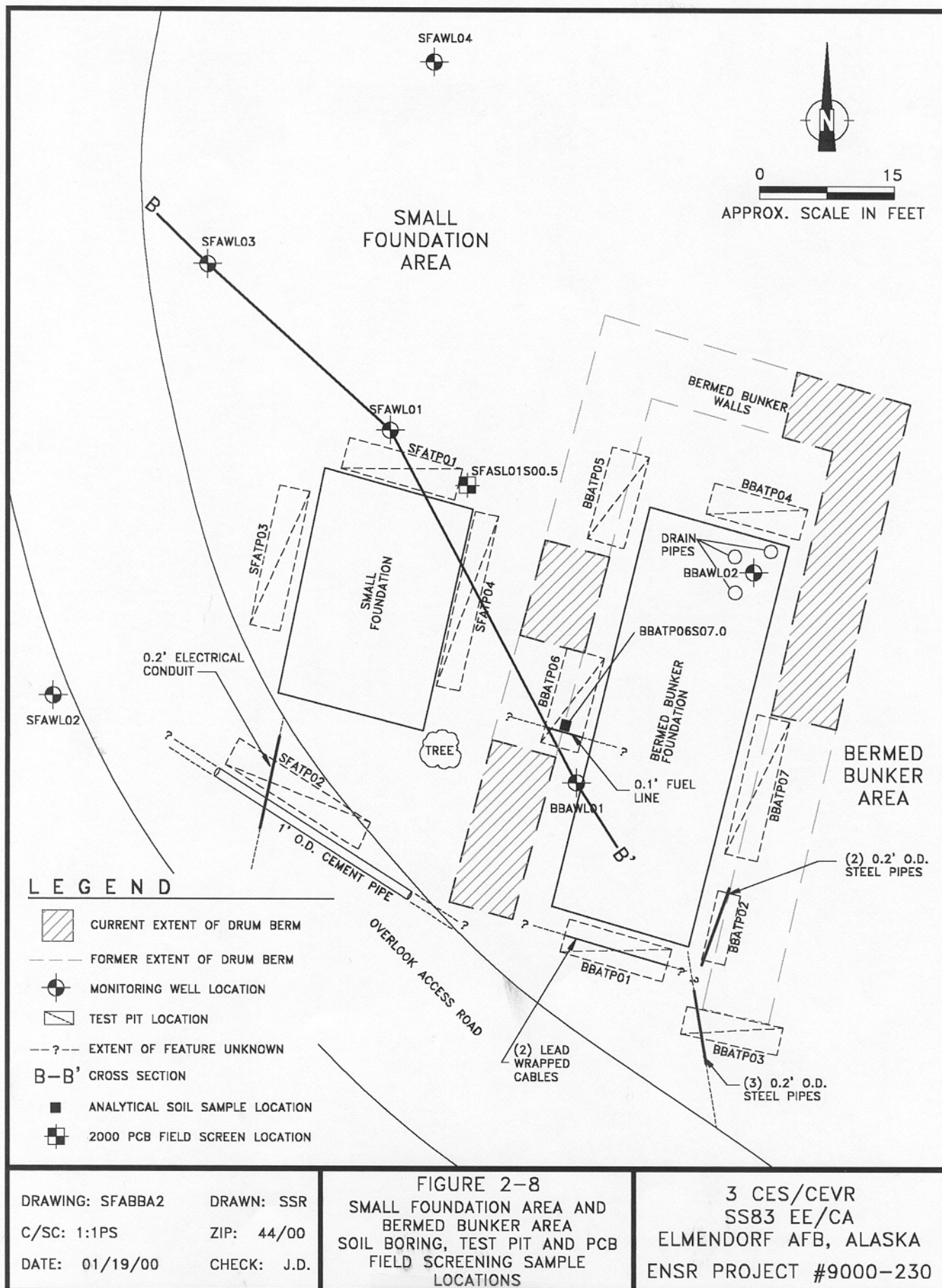
Investigations were conducted at this area in 1997 and 1998 as part of the LFI (USAF 1999b). Four screening-level PCB test samples were collected from around the perimeter of the concrete pad. PCBs were not detected in these samples. Five hand borings were then advanced and sampled to a depth of 5 feet bgs surrounding the perimeter of the pad. Organic vapor was detected in one of these samples (collected from HB-13A, located near the northeast corner of the pad). A slight petroleum hydrocarbon odor was also observed at this location. A laboratory sample collected from this boring contained DRO at 5.3 mg/kg. A test pit (TP-9) was

**Table 2-8 Landfill Area Soil Sample Analytical Results**

	Test Pit	Surface Sample
Location ID:	LNDTP06	LNDL01
Depth (feet):	5.0-5.5	12.0-12.5
Sample ID:	LNDTP06SO5.0N1	LNDL01SO12.0N1
Sample Date:	9/27/00	9/29/00
Laboratory ID(s):	1005977003	1005977002
Parameter		
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>		
Gasoline Range Organics	2.87 U	3.19 U
Diesel Range Organics	10.6 U	237
Residual Range Organics	48.3	63.4
<b>BTEX [8021B] (µg/kg)</b>		
Benzene	14.3 U	16.0 U
Ethylbenzene	57.3 U	63.8 U
m,p-Xylene (Sum of Isomers)	57.3 U	63.8 U
o-Xylene	57.3 U	63.8 U
Toluene	57.3 U	63.8 U
<b>Physical Parameters</b>		
Total Solids (percent)	88.7	81.4

**Key:**

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.



then excavated to further investigate the impacted soils at HB-13A. A petroleum sheen and odor were encountered during excavation; the LFI report did not elaborate whether groundwater was encountered in the test pit. A laboratory sample was collected from the 6 to 7 foot interval. The specific location of this sample was not reported; it was likely collected from the floor of the excavation because the test pit did not extend beyond 6 to 7 feet bgs. This sample revealed a DRO concentration of 2,300 mg/kg, which exceeds Method One Category D and Method Two migration-to-groundwater soil cleanup levels.

### **2.2.5.3 EE/CA Field Investigation Results**

Four test pits were excavated around the four sides of the concrete pad. These test pits were excavated to an average depth of 10 feet bgs and a maximum depth of 11.5 feet bgs in SFATP03. A 1-foot outer diameter cement pipe was encountered at 0.5 foot bgs during SFATP02 excavations. The cement pipe was constructed in segments of 3 feet in length. The connections between the segments were wrapped with burlap. The cement pipe trended northwest to southeast. A north-south trending 1-inch steel conduit pipe containing three electrical wires was also encountered during SFATP02 excavation.

Two additional test pits (SFATP05 and SFATP06) were excavated during the second phase of the field investigation. The purpose of the additional test pits was to investigate a possible disturbed area north of the SFA, which was devoid of brush at the beginning of the SS83 EE/CA field investigation. The additional test pits north of the SFA verified that the soils in this area were undisturbed.

Four monitoring wells were installed at the SFA. SFAWL01 was installed immediately north of the SFATP01 in order to determine the vertical extent of contamination observed in SFATP01 soils to a minimum depth of 10 feet bgs. The three remaining monitoring wells (SFAWL02, SFAWL03, and SFAWL04) were installed in the presumed downgradient direction from the source area observed in SFATP01 and SFATP04.

### **2.2.5.4 Field Screening Results**

ATH field screening was conducted on test pit soils. ATH screening results from SFATP01 and SFATP04 ranged from 2.8 to 158 ppm. The soil from these test pits was described as having strong hydrocarbon odor from the surface to total excavation depth of 10 feet bgs. The highest ATH readings occurred in sand and clay beds from 7 to 10 feet bgs. ATH screening results from the four remaining test pits exhibited readings from 0 to 1.1 ppm. An ATH measurement of 0 ppm was obtained from SFATP02 from the surface to 3 feet bgs. This sample, however, exhibited a slight fuel odor. Similarly, SFATP03 at 10 feet bgs had an ATH measurement of 0 ppm and a very slight fuel odor.

One PCB field-screening sample was collected from the north side of the SFA concrete pad. Field screening analytical results for this sample were below detection limits.

### 2.2.5.5 Laboratory Analytical Results

Soil samples were collected from three discrete depths from each soil boring. Twelve laboratory soil samples were collected for GRO, BTEX, DRO, RRO, metals, PAHs, and TOC analyses. Table 2-9 summarizes the SFA soil sample analytical results. All GRO, BTEX, DRO, and PAH analytes were below detection limits in all samples except for SFAWL01SO10.8 and SFAWL03DC2.5. Naphthalene (3.01 µg/kg) and phenanthrene (3.53 µg/kg) were the only analytes detected in SFAWL01SO10.8. The shallowest soil sample collected from drill cuttings at SFAWL03SO2.5 contained DRO (4,110 mg/kg), RRO (283 mg/kg), and several PAHs (anthracene [15.7 µg/kg], benzo(a)pyrene [1.90 µg/kg], benzo(g,h,i)perylene [2.62 µg/kg], chrysene [9.13 µg/kg], fluoranthene [4.87 µg/kg], and phenanthrene [22.4 µg/kg]). Interpretation of the DRO/RRO chromatograph indicates that the hydrocarbons observed in the drill cutting sample are weathered middle distillate products. Selenium was the only metal not detected above detection limits in the soil samples collected from the SFA.

Four samples were collected near the SFA for geotechnical analysis. Two samples were collected north of the SFA from the same location, one sample from the unsaturated zone, and the other from the saturated zone. Sieve analysis indicates that soils in the unsaturated zone at 10 feet bgs are composed of poorly graded sand with a hydraulic conductivity of  $1.3 \times 10^{-3}$ . The saturated zone sample has a hydraulic conductivity of  $2.9 \times 10^{-5}$ , and grain size analysis indicates that groundwater occurs in silty sand. Two additional samples were collected from the saturated zone at the SFA. Both samples are classified as either poorly graded or well graded gravel with silt and sand.

One groundwater sample was collected from each of the four SFA monitoring wells. Table 2-10 summarizes the SFA groundwater sample analytical results. Groundwater samples were analyzed for GRO, BTEX, VOC, DRO, RRO, metals, PAH, and nitrate-nitrite. No GRO, DRO, or RRO, was detected in any of the three SFA wells. Benzene was detected in two wells at 1.2 and 2.0 µg/L, total xylenes were detected at 4.8 and 7.7 µg/L, and toluene was detected at 5.2 and 9.8 µg/L. Naphthalene was detected in the groundwater sample collected from SFAWL01 at concentrations of 0.0631 and 0.0651 µg/L (duplicate). No other PAH analytes were detected. Elevated concentrations were reported for arsenic, barium, cadmium, chromium, lead, mercury, and silver. Nitrate/nitrite concentrations ranged from not detected to 2.59 milligrams per liter (mg/L).

Figure 2-9 is a cross-sectional view showing geology and contaminant plumes from the BBA westward across the SFA. Based on the analytical results from SFATP01, SFAWL01 and SFAWL03, and observations regarding topography and northward dip of the SFA pad, the source of the petroleum contaminants may have been a tank resting on the foundation. Analysis of a 1962 aerial photograph using accepted photo-interpretation techniques indicates that a surface release originated on the northwest corner of the pad (EPA 1989). The expression of a presumed surface release appeared to spread in a northwesterly direction and appeared to follow surface topography.



Table 2-9 Small Foundation Area Soil Sample Analytical Results

Parameter	Boring Samples					
	SFAWL01		SFAWL02		SFAWL02	
Location ID:	5.0-7.0	10.8-12.0	16.0-17.0	10.0-12.0	15.0-17.0	18.0-19.0
Depth (feet):	SFAWL01S05.0N1	SFAWL01S010.8N1	SFAWL01S016.0N1	SFAWL02S010.0N1	SFAWL02S015.0N1	SFAWL02S018.0N1
Sample ID:	6/22/00	6/22/00	6/22/00	6/22/00	6/22/00	6/22/00
Sample Date:	1003316005	1003316006	1003316007	1003316008	1003316009	1003316010
Sample QC Type:						
Laboratory ID(s):						
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>						
Gasoline Range Organics	2.70 U	3.13 U	2.61 U	2.75 U	2.73 U	2.91 U
Diesel Range Organics	10.4 U	12.0 U	9.27 U	9.62 U	9.18 U	21.7 U
Residual Range Organics	17.2 U	19.9 U	15.3 U	15.9 U	15.1 U	35.8 U
<b>BTEX [8021B] (µg/kg)</b>						
Benzene	13.5 U	15.6 U	13.1 U	13.7 U	13.6 U	14.6 U
Ethylbenzene	54.0 U	62.6 U	52.3 U	54.9 U	54.5 U	58.3 U
m,p-Xylene (Sum of Isomers)	54.0 U	62.6 U	52.3 U	54.9 U	54.5 U	58.3 U
o-Xylene	54.0 U	62.6 U	52.3 U	54.9 U	54.5 U	58.3 U
Toluene	54.0 U	62.6 U	52.3 U	54.9 U	54.5 U	58.3 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>						
Acenaphthene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Acenaphthylene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Anthracene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Benzo(a)anthracene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Benzo(a)pyrene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Benzo(b)fluoranthene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Benzo(g,h,i)perylene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Benzo(k)fluoranthene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Chrysene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Dibenzo(a,h)anthracene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Fluoranthene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Fluorene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Indeno(1,2,3-cd)pyrene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
Naphthalene	1.6 U	3.01	1.7 U	1.7 U	1.7 U	3.7 U
Phenanthrene	1.6 U	3.53	1.7 U	1.7 U	1.7 U	3.7 U
Pyrene	1.6 U	1.9 U	1.7 U	1.7 U	1.7 U	3.7 U
<b>Metals [6000/7000] (mg/kg)</b>						
Arsenic	0.934	1.90	1.69	2.94	3.75	2.69
Barium	30.1	41.7	26.9	34.8	58.6	26.9
Cadmium	0.0601	0.155	0.0398	0.0696	0.104	0.0629
Chromium	32.2	34.1	42.8	36.4	31.5	34.2
Lead	4.99	7.26	5.15	7.75	6.30	8.80
Mercury	0.0227	0.117	0.0455	0.134	0.0828	0.117
Selenium	0.244 U	0.286 U	0.234 U	0.262 U	10.5 U	0.267 U
Silver	0.0489 U	0.0617	0.0468 U	0.136	0.0525 U	0.0533 U
<b>Physical Parameters</b>						
Total Organic Carbon (mg/kg)	--	7773	--	3995	--	--
Total Solids (percent)	95.6	81.1	94.3	94.5	94.6	88.7

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

Table 2-9 Small Foundation Area Soil Sample Analytical Results (con't)

Location ID: Depth (feet): Sample ID: Sample Date: Sample QC Type: Laboratory ID(s):	Boring Samples					
	SFAWL03			SFAWL04		
	2.5-3.5 SFAWL03DC2.5N1 6/23/00 100331-4005	5.5-7.0 SFAWL03SO5.5N1 6/23/00 100331-4006	15.0-17.0 SFAWL03SO15.0N1 6/23/00 100331-4007	5.0-7.0 SFAWL04SO5.0N1 6/26/00 100351-1018	10.0-12.0 SFAWL04SO10.0N1 6/26/00 100351-1019	15.0-17.0 SFAWL04SO15.0N1 6/26/00 100351-1020 Duplicate 100351-1021
Parameter						
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>						
Gasoline Range Organics	2.77 U	2.69 U	2.94 U	2.68 U	2.59 U	2.65 U
Diesel Range Organics	4110	10.2 U	11.4 U	9.97 U	9.51 U	10.1 U
Residual Range Organics	283	16.9 U	18.7 U	16.5 U	15.7 U	16.7 U
<b>BTEX [8021B] (µg/kg)</b>						
Benzene	13.9 U	13.4 U	14.7 U	13.4 U	13.0 U	13.3 U
Ethylbenzene	55.5 U	53.7 U	58.7 U	53.5 U	51.8 U	53.1 U
m,p-Xylene (Sum of Isomers)	55.5 U	53.7 U	58.7 U	53.5 U	51.8 U	53.1 U
o-Xylene	55.5 U	53.7 U	58.7 U	53.5 U	51.8 U	53.1 U
Toluene	55.5 U	53.7 U	58.7 U	53.5 U	51.8 U	53.1 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>						
Acenaphthene	1800 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Acenaphthylene	1800 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Anthracene	15.7	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Benzo(a)anthracene	1.8 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Benzo(a)pyrene	1.90	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Benzo(b)fluoranthene	1.8 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Benzo(g,h,i)perylene	2.62	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Benzo(k)fluoranthene	1.8 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Chrysene	9.13	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Dibenzo(a,h)anthracene	1.8 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Fluoranthene	4.87	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Fluorene	1800 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Indeno(1,2,3-cd)pyrene	1.8 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Naphthalene	1800 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Phenanthrene	22.4	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Pyrene	1.8 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
<b>Metals [6000/7000] (mg/kg)</b>						
Arsenic	0.963	1.54	0.306	2.51	2.46	0.962
Barium	73.9	44.7	29.8	125	45.0	36.2
Cadmium	0.116	0.0670	0.0661	0.0630	0.0621	0.0841
Chromium	46.9	48.9	39.0	3.19	2.92	2.95
Lead	8.83	6.29	4.97	5.34	6.21	7.21
Mercury	0.0579	0.0323	0.0391	0.109	0.0594	0.0745
Selenium	0.251 U	0.258 U	5.46 U	5.04 U	0.219 U	0.261 U
Silver	0.0501 U	0.0516 U	0.0546 U	0.0504 U	0.0437 U	0.0462 U
<b>Physical Parameters</b>						
Total Organic Carbon (mg/kg)	--	6402	--	2272	3085	--
Total Solids (percent)	90.4	96.1	87.6	94.6	96.1	93.5

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.



Table 2-10 Small Foundation Area Groundwater Sample Analytical Results

Location ID:	SFAWL01		SFAWL02	SFAWL03	SFAWL04
Sample ID:	SFAWL01WG15N2	SFAWL05WG16N2	SFAWL02WG11N1	SFAWL03WG12N1	SFAWL04WG22N1
Sample Date:	8/9/00	8/9/00	7/14/00	7/14/00	7/14/00
Sample QC Type:		Duplicate			
Laboratory ID(s):	1004455005	1004455006	1003866008	1003866009	1003866010
Parameter					
Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (µg/L)					
Gasoline Range Organics	90.0 U	90.0 U	90.0 U	90.0 U	90.0 U
Diesel Range Organics	297 U	323 U	300 U	316 U	297 U
Residual Range Organics	495 U	538 U	500 U	526 U	495 U
BTEX [8021B] (µg/L)					
Benzene	0.500 U	0.500 U	1.2	2.0	0.500 U
Ethylbenzene	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
m,p-Xylene (Sum of Isomers)	2.00 U	2.00 U	4.8	5.5	2.00 U
o-Xylene	2.00 U	2.00 U	2.00 U	2.2	2.00 U
Toluene	2.00 U	2.00 U	5.2	9.8	2.00 U
Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/L)					
Acenaphthene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Acenaphthylene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Anthracene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Benzo(a)anthracene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Benzo(a)pyrene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Benzo(b)fluoranthene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Benzo(g,h,i)perylene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Benzo(k)fluoranthene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Chrysene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Dibenzo(a,h)anthracene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Fluoranthene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Fluorene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Indeno(1,2,3-cd)pyrene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Naphthalene	0.0631	0.0651	0.051 U	0.051 U	0.050 U
Phenanthrene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Pyrene	0.050 U	0.051 U	0.051 U	0.051 U	0.050 U
Volatile Organic Compounds [8260B] (µg/L) *					
No volatile organic compounds were detected.					
Metals [6000/7000] (µg/L)					
Arsenic	98.7	351	83.9	8.11	42.1
Barium	639	1880	2230	219	571
Cadmium	0.844	2.42	5.44	0.556 U	0.789
Chromium	91.2	376	1010	64.3	5.56 U
Lead	31.8	116	70.7	19.2	66.0
Mercury	2.9	7.9	13.9	0.200 U	1.16
Selenium	5.56 U	5.56 U	5.56 U	5.56 U	5.56 U
Silver	1.11 U	1.74	2.21	1.11 U	1.11 U
Geochemical Indicator (mg/L)					
Nitrate-Nitrite	5.00 U	--	2.06	2.59	2.00

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

\* No volatile organic compounds were detected; refer to Appendix H for complete listing.

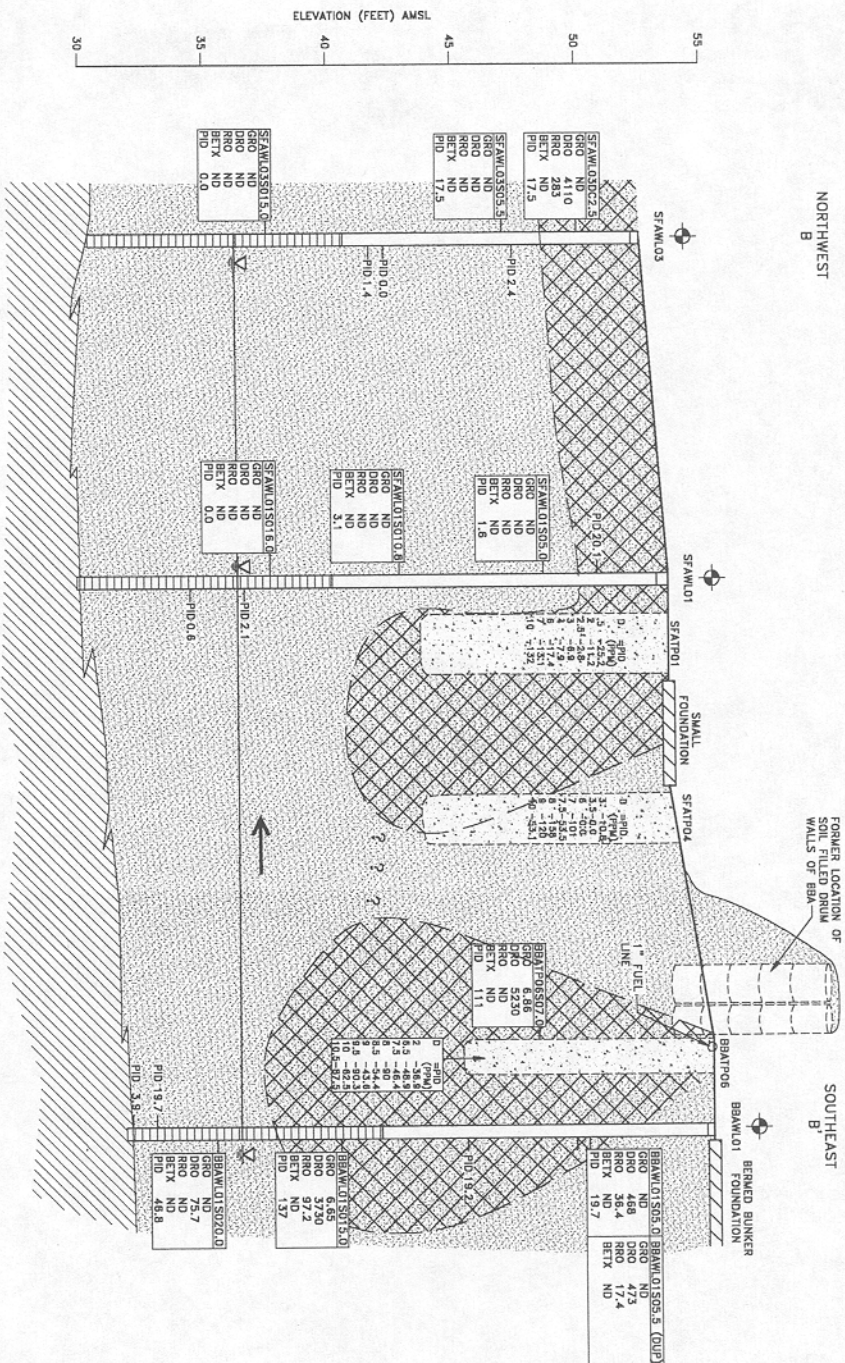


FIGURE 2-9  
SMALL FOUNDATION AREA & BERMUD  
BUNKER AREA  
CROSS SECTION B-B'  
AND ANALYTICAL RESULTS

SOURCE:			
3 CES/CEVR			
SS83 EE/CA			
ELMENDORF AFB, ALASKA			
DATE: 01/22/01			
C/SC: ZIF: 44/00			
P/N: J. DONLEY			
SCALE: AS SHOWN			
CHECKED: J. DONLEY			
PROJECT: 9000-230-600			

## **2.2.6 Bermed Bunker Area**

### **2.2.6.1 Physical Description**

The BBA consists of a 43 foot by 16 foot concrete foundation surrounded on three sides by a berm wall constructed of soil-filled 55-gallon drums (Figure 2-8). Limited drum removal activities occurred in order to excavate test pits. Drum removal activities confirmed that the BBA was constructed with soil-filled 55-gallon drums stacked three high and two deep. The bottom layer of drums was engineered such that approximately 2.5 feet of the drum extended below ground. The soil-filled drums comprising the berm are highly corroded. Debris mixed with the soil in the drums included a 6-ounce soft drink bottle, a rusted oil can, a gin bottle dated 1957, burlap bags, and a C-ration can. Several drums were spray painted with “clean rag” and “trash” labels. The northern end of the foundation has floor tile fragments and three drain pipes presumably corresponding to floor drains. During excavation of BBATP01, two 1-inch diameter, lead-wrapped cables trending east-west were excavated at 3 feet bgs. During BBATP02 excavation, two 2-inch steel pipe segments, trending N10E, were excavated at 2 feet bgs. Three 2-inch diameter steel pipes were excavated in BBATP03 at 1 foot bgs; these pipes were stacked with two on the bottom and one on top. One pipe contained a 0.5-inch insulated communications cable. The trend of the pipes was measured to be N10W. A 0.5-inch fuel line was excavated near surface from BBATP06. The trend of the fuel line was east to west, and the fuel line was broken on the west end and had an upward facing elbow on the east end. The ATH measurement from inside the 0.5-inch fuel line was 38.9 ppm, and the fuel line had a strong fuel odor.

### **2.2.6.2 Previous Investigation Results**

During the LFI (USAF 1999b), a test pit was excavated along the eastern side of the concrete pad. This pit was excavated to evaluate the origin and purpose of two pipes observed at the surface and to look for any signs of contamination. The pipes extended to 4 feet bgs and then elbowed toward the south parallel with the concrete pad. The excavation continued, following the pipes for a distance of 10 feet where one pipe appeared to be severed while the other continued. The continuing length of pipe appeared to be structurally sound and there was no evidence of contamination; therefore, the excavation was discontinued. Headspace analyses at four locations within the elongated test pit (LFITP-7) were performed at four locations within the pit; no evidence of contamination was observed.

### **2.2.6.3 EE/CA Field Investigation Results**

Prior to test pit excavation activities, several segments of the BBA soil-filled drum wall were removed in order to excavate test pits beneath the drums and adjacent to the foundation. Several soil-filled drums were randomly selected for ATH screening (see below for ATH results).

Seven test pits were excavated around the BBA. The purpose of the test pits was to determine the lateral and vertical extent of any contamination and to determine the presence of any buried



debris. Five of the test pits (BBATP01, BBATP02, BBATP3, BBATP04, and BBATP05) were excavated to an average total depth of 6 to 7.5 feet bgs. These test pits were terminated at this depth interval because contamination was not evident based on lack of elevated ATH measurements and olfactory observations. BBATP06 was excavated to a depth of 10.5 feet bgs because elevated ATH measurements and accompanying fuel odors were observed from 0.4 feet bgs to the maximum depth of the excavation at 10.5 feet bgs. BBATP07 was excavated to a depth of 10 feet bgs to potentially intercept the contamination observed in BBATP06 at depth.

Two monitoring wells were installed at the BBA. BBAWL01 was installed immediately south of BBATP06 in order to determine the vertical extent of contamination observed in BBATP06 soils. The second monitoring well (BBAWL02) was installed in the concrete pad between the three floor drains. The purpose of BBAWL02 was to assess potential contamination associated with the floor drains. Additionally, if analytical results indicated that BBAWL02 was not impacted by the floor drains, it could serve as an upgradient well to the contamination observed in SFATP01.

#### **2.2.6.4 Field Screening Results**

Several soil-filled drums were removed from the berm wall to allow of ATH field screening and excavation of test pits. A total of 21 soil filled drums were randomly selected for ATH measurements. All ATH readings from the soil filled drums were non-detect.

Seven test pits were excavated around the BBA foundation. ATH measurements were collected from all test pits; results were 0.0 ppm for all test pit samples except BBATP06. The first elevated ATH measurement of 1.5 ppm from BBATP06 was recorded at 0.4 feet bgs, beneath the 0.5-inch fuel line, where a moderate fuel odor was noted. ATH readings increased to a maximum reading of 111 ppm collected at 7.0 feet bgs, with a very strong fuel odor. The fuel odor and elevated ATH readings continued to the total excavation depth of 10.5 feet.

#### **2.2.6.5 Laboratory Analytical Results**

One soil sample was collected from BBATP06. The test pit soil sample was analyzed for GRO, BTEX, DRO, RRO, and PAH. Analytes not detected above detection limits for BBATP06SO7.0 included RRO, BTEX, and PAH. DRO (5,230 mg/kg) and GRO (6.86 mg/kg) were the only analytes detected in BBATP06SO7.0. Soil sample results are summarized on Table 2-11.

Soil samples were also collected from three discrete depths from each soil boring. Six laboratory soil samples were collected for GRO, BTEX, DRO, RRO, PAH, and TOC. Soil samples collected from BBAWL02 were also analyzed for metals. BTEX analytes were below detection limits in all soils collected from soil borings BBAWL01 and BBAWL02. GRO was detected in one sample (BBAWL01SO15.0) at a concentration of 6.65 mg/kg. DRO was detected in all BBAWL01 samples ranging in concentration from 75.7 mg/kg (BBAWL01SO20.0) to 3,730 mg/kg (BBAWL01SO15.0). RRO was detected in three samples ranging in concentration from 21.8 mg/kg (BBAWL02SO10.0) to 97.2 mg/kg (BBAWL01SO15.0).

Table 2-11 Bermed Bunker Area Soil Sample Analytical Results

Location ID: Depth (feet): Sample ID: Sample Date: Sample QC Type: Laboratory ID(s):	Test Pit Sample BBATP06 7.0-9.0 BBATP06SO7.0N1 6/12/00 1002985002	Boring Samples				
		BBAWL01		BBAWL02		
		5-7	15-17	20-22	6.5-7.0	10-12
		BBAWL01SO5.0N1 6/21/00 1003315001	BBAWL01SO15.0N1 6/21/00 1003315003	BBAWL01SO20.0N1 6/21/00 1003315004	BBAWL02SO6.5N1 6/23/00 1003314001	BBAWL02SO10.0N1 6/23/00 1003314002
Parameter						
Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)						
Gasoline Range Organics	6.86	2.85 U	6.65	3.00 U	2.85 U	2.61 U
Diesel Range Organics	5230	468	3730	75.7	10.8 U	10.3 U
Residual Range Organics	186 U	36.4	97.2	33.9 U	17.8 U	21.8
BTEX [8021B] (µg/kg)						
Benzene	14.5 U	14.3 U	12.8 U	15.0 U	14.3 U	13.1 U
Ethylbenzene	58.0 U	57.0 U	51.3 U	60.0 U	57.1 U	52.2 U
m,p-Xylene (Sum of Isomers)	58.0 U	57.0 U	51.3 U	60.0 U	57.1 U	52.2 U
o-Xylene	58.0 U	57.0 U	51.3 U	60.0 U	57.1 U	52.2 U
Toluene	58.0 U	57.0 U	51.3 U	60.0 U	57.1 U	52.2 U
Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)						
Acenaphthene	190 U	1.8 U	1600 U	3.6 U	1.8 U	1.7 U
Acenaphthylene	190 U	1.8 U	1600 U	3.6 U	1.8 U	1.7 U
Anthracene	190 U	1.8 U	1.6 U	3.6 U	1.8 U	1.7 U
Benzo(a)anthracene	190 U	1.8 U	1.6 U	3.6 U	1.8 U	1.7 U
Benzo(a)pyrene	190 U	1.8 U	1.6 U	3.6 U	1.8 U	1.7 U
Benzo(b)fluoranthene	190 U	1.8 U	1.6 U	3.6 U	1.8 U	1.7 U
Benzo(g,h,i)perylene	190 U	1.8 U	1.6 U	3.6 U	1.8 U	1.7 U
Benzo(k)fluoranthene	190 U	1.8 U	1.6 U	3.6 U	1.8 U	1.7 U
Chrysene	190 U	1.8 U	4.95	3.6 U	1.8 U	1.7 U
Dibenzo(a,h)anthracene	190 U	1.8 U	1.6 U	3.6 U	1.8 U	1.7 U
Fluoranthene	190 U	1.8 U	1.6 U	3.6 U	1.8 U	1.7 U
Fluorene	190 U	1.8 U	1600 U	3.6 U	1.8 U	1.7 U
Indeno(1,2,3-cd)pyrene	190 U	1.8 U	1.6 U	3.6 U	1.8 U	1.7 U
Naphthalene	190 U	1.8 U	1600 U	3.6 U	1.8 U	1.7 U
Phenanthrene	190 U	1.8 U	1.6 U	3.6 U	1.8 U	1.7 U
Pyrene	190 U	1.8 U	1.6 U	3.6 U	1.8 U	1.7 U
Metals [6000/7000] (mg/kg)						
Arsenic	--	--	--	--	1.46	0.682
Barium	--	--	--	--	39.6	68.2
Cadmium	--	--	--	--	0.0575	0.0356
Chromium	--	--	--	--	38.1	30.4
Lead	--	--	--	--	4.23	4.74
Mercury	--	--	--	--	0.0515	0.0351
Selenium	--	--	--	--	0.216 U	0.255 U
Silver	--	--	--	--	0.0432 U	0.0509 U
Physical Parameters						
Total Organic Carbon (mg/kg)	--	--	--	--	--	--
Total Solids (percent)	87.8	88.7	89.6	89.7	89.0	96.3
						2783
						97.3

Key:

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

Chrysene at a concentration of 4.95 µg/kg was the only PAH detected in any of the samples (BBAWL02SO15.0) collected from the soil borings. Metals reported above detection limits in BBAWL02 included arsenic, barium, cadmium, chromium, lead, and mercury. TOC was detected at a concentration of 2,783 mg/kg in BBAWL02SO15.0. Interpretation of the DRO/RRO chromatographs indicates that the hydrocarbons observed in the soil samples from the BBA are weathered middle distillate products. Figure 2-9 is a cross-section showing subsurface geology and contaminant concentrations across the BBA.

Groundwater samples were collected from the two BBA monitoring wells (BBAWL01 and BBAWL02). A very slight sheen was observed on the surface of purge water and a moderate petroleum odor was noted at BBAWL01, but no free product was measured in the well itself. Table 2-12 summarizes the BBA groundwater sample analytical results. Groundwater samples were analyzed for GRO, BTEX, VOC, DRO, RRO, metals, PAH, and nitrate-nitrite. Arsenic, barium, cadmium, chromium, lead, and mercury were the only analytes detected in BBAWL02; no organic analytes were detected. BBAWL02 nitrate/nitrite was detected at 2.02 mg/L. GRO, RRO, BTEX, and nitrate/nitrite were below detection limits in BBAWL01. DRO was detected in BBAWL01 at 1,450 µg/L (2,410 µg/L in the field duplicate). Naphthalene was detected at 0.0528 µg/L (0.0744 µg/L in the field duplicate); no other PAH analytes were detected in BBAWL01. Metals detected in BBAWL01 included barium and chromium. Interpretation of the DRO/RRO chromatographs indicates that the hydrocarbons observed in the groundwater samples are dissolved, weathered middle distillate products.

It is likely that the source of the petroleum product observed in BBATP06 and BBAWL01 is the 0.5-inch fuel line that was excavated at the surface near these locations. It is probable that the fuel line was associated with the presumed tank source on the SFA pad.

## **2.2.7 Former Underground Bunker Area**

### **2.2.7.1 Physical Description**

The UBA as visible from the ground surface formerly consisted of a 20 foot by 22 foot concrete slab roof that was exposed flush with the grade of the ground surface. The entrance to the former bunker was on the south side between two soil berms.

### **2.2.7.2 Previous Investigation Results**

During the LFI (USAF 1999b), two soil samples from a depth of 3 feet bgs were collected from the bunker floor and field-screened for organic vapors using headspace analysis. No evidence of contamination was found; therefore, there were no laboratory samples collected at this location.

Table 2-12 Bermed Bunker Area Groundwater Sample Analytical Results

Location ID:	BBAWL01		BBAWL02
Sample ID:	BBAWL01WG18N2	BBAWL03WG19N2	BBAWL02WG13N1
Sample Date:	8/9/00	8/9/00	7/14/00
Sample QC Type:		Duplicate	
Laboratory ID(s):	1004455001	1004455002	1003866002
Parameter			
Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (µg/L)			
Gasoline Range Organics	90.0 U	90.0 U	90.0 U
Diesel Range Organics	1450	2410	303 U
Residual Range Organics	495 U	495 U	505 U
BTEX [8021B] (µg/L)			
Benzene	0.500 U	0.500 U	0.500 U
Ethylbenzene	2.00 U	2.00 U	2.00 U
m,p-Xylene (Sum of Isomers)	2.00 U	2.00 U	2.00 U
o-Xylene	2.00 U	2.00 U	2.00 U
Toluene	2.00 U	2.00 U	2.00 U
Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/L)			
Acenaphthene	0.050 U	0.050 U	0.050 U
Acenaphthylene	0.050 U	0.050 U	0.050 U
Anthracene	0.050 U	0.050 U	0.050 U
Benzo(a)anthracene	0.050 U	0.050 U	0.050 U
Benzo(a)pyrene	0.050 U	0.050 U	0.050 U
Benzo(b)fluoranthene	0.050 U	0.050 U	0.050 U
Benzo(g,h,i)perylene	0.050 U	0.050 U	0.050 U
Benzo(k)fluoranthene	0.050 U	0.050 U	0.050 U
Chrysene	0.050 U	0.050 U	0.050 U
Dibenzo(a,h)anthracene	0.050 U	0.050 U	0.050 U
Fluoranthene	0.050 U	0.050 U	0.050 U
Fluorene	0.050 U	0.050 U	0.050 U
Indeno(1,2,3-cd)pyrene	0.050 U	0.050 U	0.050 U
Naphthalene	0.0528	0.0744	0.050 U
Phenanthrene	0.050 U	0.050 U	0.050 U
Pyrene	0.050 U	0.050 U	0.050 U
Volatile Organic Compounds [8260B] (µg/L) *			
No volatile organic compounds were detected.			
Metals [6000/7000] (µg/L)			
Arsenic	5.56 U	5.56 U	109
Barium	84.3	107	780
Cadmium	0.556 U	0.556 U	2.57
Chromium	9.67	13.4	181
Lead	5.56 U	5.56 U	43.9
Mercury	0.2 U	0.2 U	1.94
Selenium	5.56 U	5.56 U	5.56 U
Silver	1.11 U	1.11 U	1.11 U
Geochemical Indicator (mg/L)			
Nitrate-Nitrite	5.00 U	--	2.02

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

\* No volatile organic compounds were detected; refer to Appendix H for complete listing.

### **2.2.7.3 EE/CA Field Investigation Results**

The bunker was excavated and demolished between May 26 and June 1, 2000. The entire excavation of the former bunker was considered a test pit (UBATP02). Figure 2-10 illustrates construction details that were determined at the time of excavation of the bunker. The bunker was constructed such that the concrete roof, reinforced with chain-link fence, rested on top of tar-covered sand bags and 1-foot by 2-foot concrete footings at ground surface. The bunker exterior walls consisted of approximately 55 soil-filled 55-gallon drums stacked 2 high and resting on undisturbed soil. The interior walls consisted of wood beams and painted fiberboard. The 8-foot by 6-foot floor of the bunker was constructed of 4-inch thick unreinforced concrete. The concrete floor had no cracks and no drains. Buried telephone conduit, electrical cable, and a 3-inch diameter clay pipe were encountered south of the entrance of the former bunker during removal of debris. All visible concrete, wood, and soil-filled drums were removed and disposed of as described in Section 2.1.15. Trash debris that was present inside the bunker at the time of excavation included three 1-gallon metal paint cans, one 1-gallon plastic paint can, one empty mineral spirits can, numerous spray paint cans, brown ceramic insulator pieces, and an empty "dry erase solvent" can.

### **2.2.7.4 Field Screening Results**

Approximately six 55-gallon soil-filled drums were randomly selected for screening using ATH methods. All ATH/PID results were non-detect. No fuel odor was detected in any of the drums screened. ATH measurements were also collected from soil and debris on top of the floor, along the edges of the floor, beneath the floor, and from beneath the connection of one segment of the 3-inch clay pipe. All ATH screening conducted from above, below, and around the edges of the floor was non-detect. An ATH sample collected beneath the clay pipe had a result of 0.9 ppm. The soil at this location was described as black sandy gravel with no fuel odor.

### **2.2.7.5 Laboratory Analytical Results**

Two confirmation laboratory samples (UBATP02SO10.0 and UBATP02SO10.5) were collected from beneath the floor of the former bunker. Analytical results indicate that GRO, BTEX, DRO, RRO, and PAH concentrations are below detection limits, with the exception that naphthalene was detected at 2.20 µg/kg (Table 2-13).

## **2.2.8 Docking Area**

### **2.2.8.1 Physical Description**

The DKA is located immediately west of the Rosette Antenna and is an easterly-facing "U"-shaped structure likely constructed of several hundred soil-filled 55-gallon drums. The stacking configuration and estimate on quantities of soil-filled drums is not known since the structure was not deconstructed during the EE/CA field program. The structure walls are estimated to be approximately 12 feet high. The top and exterior faces of the structure are covered with a



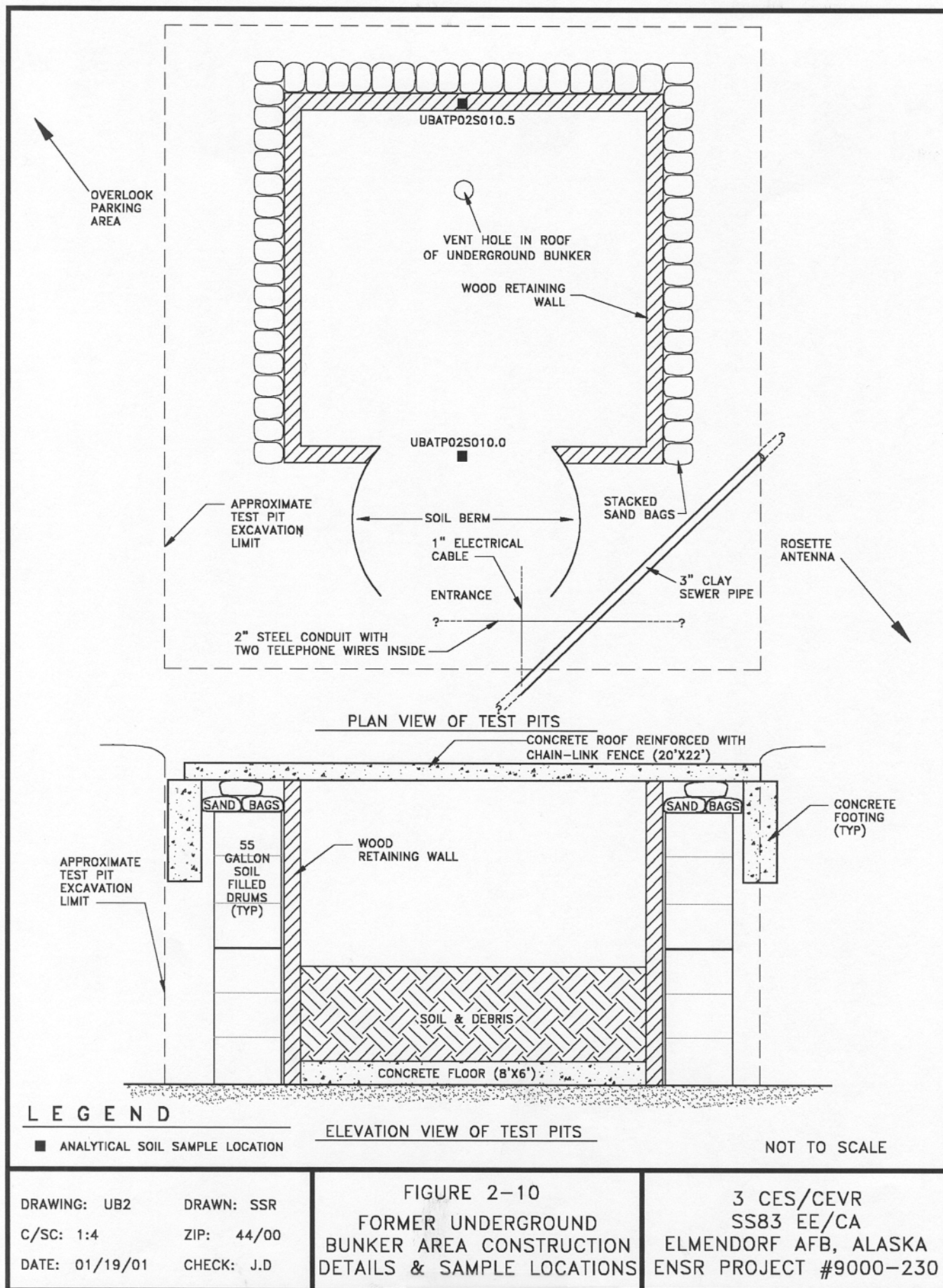


Table 2-13 Underground Bunker Area Soil Sample Analytical Results

Parameter	Test Pit Samples	
	UBATP02	
	10.0-10.5	10.5-11.0
	UBATP02SO10.0N1	UBATP02SO10.5N1
	6/19/00	6/19/00
Location ID:	1003220014	1003220015
Depth (feet):		
Sample ID:		
Sample Date:		
Laboratory ID(s):		
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>		
Gasoline Range Organics	2.76 U	2.75 U
Diesel Range Organics	10.9 U	9.66 U
Residual Range Organics	18.0 U	15.9 U
<b>BTEX [8021B] (µg/kg)</b>		
Benzene	13.8 U	13.7 U
Ethylbenzene	55.2 U	54.9 U
m,p-Xylene (Sum of Isomers)	55.2 U	54.9 U
o-Xylene	55.2 U	54.9 U
Toluene	55.2 U	54.9 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>		
Acenaphthene	1.8 U	1.8 U
Acenaphthylene	1.8 U	1.8 U
Anthracene	1.8 U	1.8 U
Benzo(a)anthracene	1.8 U	1.8 U
Benzo(a)pyrene	1.8 U	1.8 U
Benzo(b)fluoranthene	1.8 U	1.8 U
Benzo(g,h,i)perylene	1.8 U	1.8 U
Benzo(k)fluoranthene	1.8 U	1.8 U
Chrysene	1.8 U	1.8 U
Dibenzo(a,h)anthracene	1.8 U	1.8 U
Fluoranthene	1.8 U	1.8 U
Fluorene	1.8 U	1.8 U
Indeno(1,2,3-cd)pyrene	1.8 U	1.8 U
Naphthalene	2.20	1.8 U
Phenanthrene	1.8 U	1.8 U
Pyrene	1.8 U	1.8 U
<b>Physical Parameters</b>		
Total Solids (percent)	90.3	92.1

**Key:**

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

mound of soil approximately 3 feet deep. A man door is located in the center of the western facing wall. A 32-foot by 12-foot by 3-foot high decaying wooden platform was located within the center of the structure. Concrete steps leading up to the platform were located on the east side of the platform. Figure 2-11 shows the DKA and its site features.

### **2.2.8.2 Previous Investigation Results**

Two hand-augered borings were completed to a depth of 5 feet bgs in 1997 as part of the LFI (USAF 1999b). One boring was located within the collapsed wooden structure, and the other was located between the structure and the southern drum wall. There was no evidence of soil staining or headspace analysis results above zero at either of these borings; therefore, no samples were submitted for laboratory analysis.

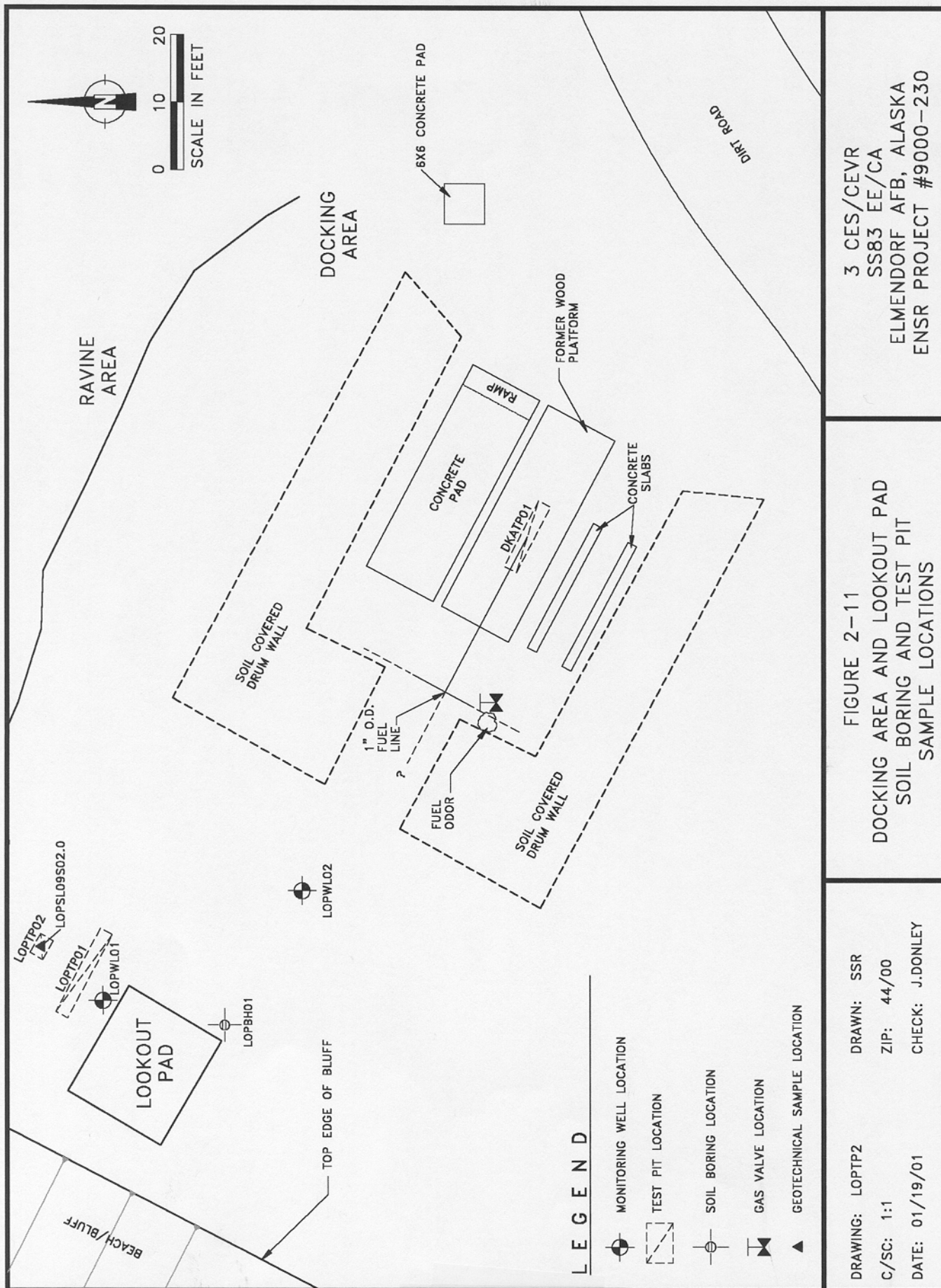
Following further historical research, seven soil samples were collected from five sample locations in the docking area and submitted to the laboratory for PCB analysis in 1998 as part of the LFI. Four initial samples collected from the perimeter of the collapsed wooden structure revealed levels of PCBs above the detection limit in the 0-to 6-inch depth interval. Two additional samples were collected approximately 2 months later from 2 to 3 feet bgs at two of the previous perimeter sample locations. These additional samples did not reveal PCBs above the detection limit. There were no PCBs reported above the detection limit in a seventh sample, collected from within the wooden structure.

Laboratory samples were submitted only for PCB analysis. The only congener detected was PCB-Aroclor 1254 at concentrations below regulatory standards ranging from 18 to 90 µg/kg. mg/kg

### **2.2.8.3 EE/CA Field Investigation Activities**

Before the excavation of any test pits, the decaying wooden platform and concrete steps were removed to access the soil beneath the platform. Removal of the wooden platform revealed that it was flanked on the north by a concrete pad and ramp, and to the south by two 2-foot wide concrete walks. The concrete was not disturbed during platform removal or test pit excavation. A pipeline was encountered trending east to west beneath the wooden platform; this pipeline is believed to have been a fuel line due to the presence of a fuel odor. The fuel line terminates approximately in the center of the former wooden platform with an upward facing "L" joint. The west end of the fuel line just east of the man door was observed to intersect a north-south trending pipe at a four-way junction. A fuel odor was observed beneath the junction after the completion of the platform removal. The terminus of the north-south pipe is unknown. The extent of the fuel line west of the junction was not determined, however the line trended out the man door. Several pipes fitted with gas connections and shutoff valves were located and remain within the western corner of the DKA. Two heaters were removed from inside of the DKA during platform removal. The heaters were on their sides and had fallen through the rotting wooden platform before removal. A 2-foot by 2-foot galvanized steel plate was also removed during the platform removal.





One test pit (DKATP01) was excavated to 7.5 feet bgs within the center of the DKA, centered beneath the fuel line in the center of the former wooden platform. No debris or elevated ATH measurements were encountered during DKATP01 excavation, thus no laboratory analytical samples were collected.

#### **2.2.8.4 Field Screening Results**

ATH measurements were collected from DKATP01 soils. All ATH measurements were nondetect, and no fuel odor was observed.

Thirty-two PCB field screening samples were collected from surface soils within and outside of the DKA area. These surface samples were also evaluated for petroleum odor; only sample DKASL31SO0.5 exhibited a fuel odor. Figure 2-12 shows the PCB sample locations and results. Analytical results of the PCB field screening indicate that PCBs were not detected above the detection limit. Eight confirmation samples were submitted for analysis by an off-site laboratory. Laboratory analytical results indicate that one sample (DKASL26SO0.5) had an Aroclor 1254 detection of 226 µg/kg. Table 2-14 provides analytical results for DKA soil samples.

### **2.2.9 Lookout Pad**

#### **2.2.9.1 Physical Description**

The LOP was determined to be an additional area of investigation when a fuel odor was detected in the wind upwelling from the bluff in this location. The LOP is located approximately 30 feet west of the DKA (Figure 2-11). The LOP is a 17-foot by 18-foot concrete pad that was situated 5 feet east of the edge of the bluff at the commencement of the SS83 EE/CA field investigation in May 2000. A site visit conducted in January 2001 revealed that a 6-foot by 4-foot section of bluff had catastrophically eroded from the bluff face immediately adjacent to the center of the LOP. As of January 2001, the LOP was situated 1.5 feet east of the top edge of the bluff. One galvanized guy wire tie-down was located in the pad. It is unknown what the tie down was securing. The concrete pad has several cracks in its surface.

Materials remaining in the area (e.g., concrete foundation, tie-down anchor points, and a segment of piping presumed to have once led to the DKA) suggest that the pad may have served as a foundation for an aboveground storage tank.

#### **2.2.9.2 Field Investigation Results**

Two test pits were excavated north of the LOP concrete pad. The purpose of LOPTP01 was to determine the lateral and vertical extent of contamination observed in bluff soils. LOPTP01 was excavated to a total depth of 7 feet bgs. A strong petroleum odor was present in a silty/clayey fine sand from 2 to 6 feet bgs. No fuel odor was noted in a coarse sand bed from 6 to 7 feet

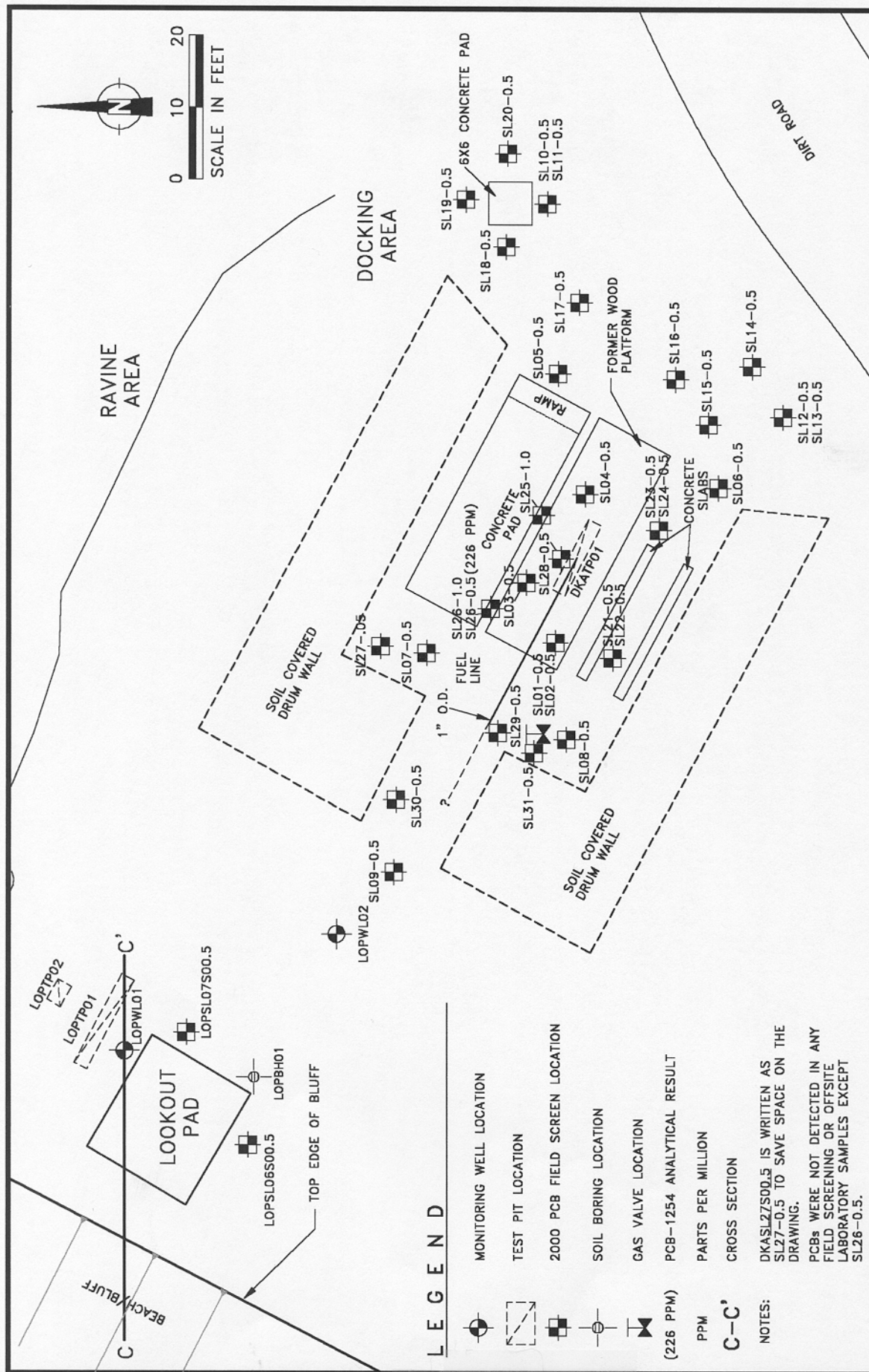


FIGURE 2-12

DOCKING AREA AND LOOKOUT PAD  
PCB FIELD SCREENING SAMPLE  
LOCATIONS AND RESULTS

3 CES/CEVR  
SS83 EE/CA  
ELMENDORF AFB, ALASKA  
ENSR PROJECT #9000-230

DRAWING: LOPPCB  
C/SC: 1:1  
DATE: 01/19/01

DRAWN: SSR  
ZIP: 44/00  
CHECK: J.DONLEY



Table 2-14 Docking Area Soil Sample Analytical Results

Parameter	Surface Samples							
	DKASL25	DKASL26		DKASL27	DKASL28	DKASL29	DKASL30	DKASL31
	0.5-0.7	0.5-0.7	1.0-1.2	0.5-0.7	0.5-0.7	0.5-0.7	0.5-0.7	0.5-0.7
	DKASL25SO0.5N1 9/21/00 1005694001	DKASL26SO0.5N1 9/21/00 1005694002	DKASL26SO1.0N1 9/21/00 1005694003	DKASL27SO0.5N1 9/21/00 1005694004	DKASL28SO0.5N1 9/21/00 1005694005	DKASL29SO0.5N1 9/21/00 1005694006	DKASL30SO0.5N1 9/21/00 1005694007	DKASL31SO0.5N1 9/21/00 1005694008
Polychlorinated Biphenyls [8082] (µg/kg)								
PCB-1016 (Aroclor 1016)	50.6 U	46.7 U	52.8 U	54.9 U	44.6 U	49.6 U	48.6 U	53.6 U
PCB-1221 (Aroclor 1221)	50.6 U	46.7 U	52.8 U	54.9 U	44.6 U	49.6 U	48.6 U	53.6 U
PCB-1232 (Aroclor 1232)	50.6 U	46.7 U	52.8 U	54.9 U	44.6 U	49.6 U	48.6 U	53.6 U
PCB-1242 (Aroclor 1242)	50.6 U	46.7 U	52.8 U	54.9 U	44.6 U	49.6 U	48.6 U	53.6 U
PCB-1248 (Aroclor 1248)	50.6 U	46.7 U	52.8 U	54.9 U	44.6 U	49.6 U	48.6 U	53.6 U
PCB-1254 (Aroclor 1254)	50.6 U	226	52.8 U	54.9 U	44.6 U	49.6 U	48.6 U	53.6 U
PCB-1260 (Aroclor 1260)	50.6 U	46.7 U	52.8 U	54.9 U	44.6 U	49.6 U	48.6 U	53.6 U
PCB Field Screening Enslys™ Soil Test Kit [4020] (ppm)								
PCB-1254 (Aroclor 1254)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Physical Parameters								
Total Solids (percent)	90.0	93.1	85.9	86.9	91.9	89.8	94.1	85.0

**Key:**

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.



bgs. The purpose of LOPTP02 was to collect a geotechnical sample from the 2-to 6-foot interval observed in LOPTP01.

One soil boring and two monitoring wells were installed at the LOP. Monitoring well LOPWL01 was installed between the concrete pad and LOPTP01 to determine the vertical extent of contamination observed in LOPTP01 and to determine whether groundwater was being impacted by that contamination. LOPWL02 was installed as an upgradient well to LOPWL01 and as a downgradient well to the DKA. LOPBH01 was installed at the southeast corner of the LOP to determine the lateral and vertical extent of contamination observed in LOPTP01.

Five surface soil samples were collected from the bluff face immediately west of the LOP. The purpose of the bluff face samples was to determine contaminant concentrations present on the bluff at various depths.

### **2.2.9.3 Field Screening Results**

ATH measurements were collected from test pit soils and during drilling activities. ATH readings accompanied by fuel odor indicated that fuel contamination was present in LOPTP01 and LOPWL01. The highest ATH measurement (256 ppm) was observed in LOPTP01 at 2.5 feet bgs in clay to silty fine sand. Elevated ATH readings between 13.5 ppm to 69.9 ppm continued until 7 feet bgs where ATH measurements were 0.0 ppm. LOPWL01 ATH readings were highest near surface at 1.0 feet bgs (157 ppm) and decreased to non detect at 20.0 feet bgs.

Two surface soil samples were collected for PCB field screening (shown in Figure 2-12). Field screening analytical results indicate that PCBs were not detected above method detection limits.

### **2.2.9.4 Laboratory Analytical Results**

Ten subsurface soil samples were collected from the LOP soil borings and were analyzed for GRO, BTEX, DRO, RRO, and PAH. Table 2-15 summarizes the LOP subsurface soil analytical results. GRO was detected in one sample (LOPWL01SO1.0) at 4.39 mg/kg. DRO was detected in four samples ranging from 18.0 mg/kg (LOPWL02SO20.0) to 20,400 mg/kg (LOPWL01SO1.0). RRO was detected in five subsurface soil samples ranging in concentration from 17.0 mg/kg (LOPWL02SO10.0) to 38.8 mg/kg (LOPWL02SO5.0). Chrysene was detected in only one sample (LOPWL01SO1.0) at 7.84 µg/kg, and naphthalene was detected in one sample (LOPWL01SO15.0) at 2.28 µg/kg; no other PAHs were detected. Interpretation of the DRO/RRO chromatographs indicates that the hydrocarbons present in the subsurface soil samples are weathered middle distillate products.

Five surface soil samples collected from the bluff face immediately west of the LOP were analyzed for GRO, BTEX, DRO, RRO, and PAH. Table 2-16 summarizes the surface soil analytical results. Figure 2-13 shows an oblique view of the bluff and identifies the surface soil sample locations. GRO and BTEX were not detected above detection limits in any of the

Table 2-15 Lookout Pad Area Subsurface Soil Sample Analytical Results

Parameter	Boring Samples		
	LOPBH01		
	5.0-7.0	10.0-12.0	15.0-17.0
	LOPBH01SO5.0N1	LOPBH01SO10.0N1	LOPBH01SO15.0N1
	6/26/00	6/26/00	6/26/00
Location ID:	1003511011	1003511012	1003511013
Depth (feet):			
Sample ID:			
Sample Date:			
Laboratory ID(s):			
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>			
Gasoline Range Organics	2.77 U	2.69 U	2.67 U
Diesel Range Organics	9.96 U	9.67 U	10.1 U
Residual Range Organics	16.4 U	16.0 U	16.6 U
<b>BTEX [8021B] (µg/kg)</b>			
Benzene	13.9 U	13.5 U	13.4 U
Ethylbenzene	55.5 U	53.9 U	53.4 U
m,p-Xylene (Sum of Isomers)	55.5 U	53.9 U	53.4 U
o-Xylene	55.5 U	53.9 U	53.4 U
Toluene	55.5 U	53.9 U	53.4 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>			
Acenaphthene	1.7 U	1.7 U	1.7 U
Acenaphthylene	1.7 U	1.7 U	1.7 U
Anthracene	1.7 U	1.7 U	1.7 U
Benzo(a)anthracene	1.7 U	1.7 U	1.7 U
Benzo(a)pyrene	1.7 U	1.7 U	1.7 U
Benzo(b)fluoranthene	1.7 U	1.7 U	1.7 U
Benzo(g,h,i)perylene	1.7 U	1.7 U	1.7 U
Benzo(k)fluoranthene	1.7 U	1.7 U	1.7 U
Chrysene	1.7 U	1.7 U	1.7 U
Dibenzo(a,h)anthracene	1.7 U	1.7 U	1.7 U
Fluoranthene	1.7 U	1.7 U	1.7 U
Fluorene	1.7 U	1.7 U	1.7 U
Indeno(1,2,3-cd)pyrene	1.7 U	1.7 U	1.7 U
Naphthalene	1.7 U	1.7 U	2.28
Phenanthrene	1.7 U	1.7 U	1.7 U
Pyrene	1.7 U	1.7 U	1.7 U
<b>Physical Parameters</b>			
Total Solids (percent)	92.4	95.7	94.2

**Key:**

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

Table 2-15 Lookout Pad Area Subsurface Soil Sample Analytical Results (con't)

Parameter	Boring Samples		
	LOPWL01		
	1.0-2.0	10.0-12.0	25.0-27.0
	Location ID: LOPWL01SO1.0N1	Location ID: LOPWL01SO10.0N1	Location ID: LOPWL01SO25.0N1
	Depth (feet): 6/26/00	Depth (feet): 6/26/00	Depth (feet): 6/26/00
Sample ID:	1003511014	1003511015	1003511016
Sample Date:			
Laboratory ID(s):			
Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)			
Gasoline Range Organics	4.39	2.74 U	3.00 U
Diesel Range Organics	20400	205	11.7 U
Residual Range Organics	1090 U	19.0	19.4 U
BTEX [8021B] (µg/kg)			
Benzene	18.0 U	13.7 U	15.0 U
Ethylbenzene	71.8 U	54.7 U	60.1 U
m,p-Xylene (Sum of Isomers)	71.8 U	54.7 U	60.1 U
o-Xylene	71.8 U	54.7 U	60.1 U
Toluene	71.8 U	54.7 U	60.1 U
Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)			
Acenaphthene	4700 U	2.5 U	3.8 U
Acenaphthylene	4700 U	2.5 U	3.8 U
Anthracene	4.7 U	2.5 U	3.8 U
Benzo(a)anthracene	4.7 U	2.5 U	3.8 U
Benzo(a)pyrene	4.7 U	2.5 U	3.8 U
Benzo(b)fluoranthene	4.7 U	2.5 U	3.8 U
Benzo(g,h,i)perylene	4.7 U	2.5 U	3.8 U
Benzo(k)fluoranthene	4.7 U	2.5 U	3.8 U
Chrysene	7.84	2.5 U	3.8 U
Dibenzo(a,h)anthracene	4.7 U	2.5 U	3.8 U
Fluoranthene	4.7 U	2.5 U	3.8 U
Fluorene	4700 U	2.5 U	3.8 U
Indeno(1,2,3-cd)pyrene	4.7 U	2.5 U	3.8 U
Naphthalene	4700 U	2.5 U	3.8 U
Phenanthrene	4.7 U	2.5 U	3.8 U
Pyrene	4.7 U	2.5 U	3.8 U
Physical Parameters			
Total Solids (percent)	70.2	92.4	84.3

**Key:**

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.



Table 2-15 Lookout Pad Area Subsurface Soil Sample Analytical Results (con't)

Parameter	Boring Samples			
	LOPWL02			
	5.0-7.0	10.0-12.0	15.0-17.0	20.0-22.0
	Location ID: LOPWL02SO5.0N1	LOPWL02SO10.0N1	LOPWL02SO15.0N1	LOPWL02SO20.0N1
	Depth (feet): 6/29/00	6/29/00	6/29/00	6/29/00
	Sample ID: 1003586001	1003586002	1003586003	1003586004
	Sample Date:			
	Laboratory ID(s):			
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>				
Gasoline Range Organics	2.82 U	2.58 U	2.68 U	2.98 U
Diesel Range Organics	21.8	10.3 U	10.4 U	18.0
Residual Range Organics	38.8	17.0	22.7	31.8
<b>BTEX [8021B] (µg/kg)</b>				
Benzene	14.1 U	12.9 U	13.4 U	14.9 U
Ethylbenzene	56.5 U	51.6 U	53.6 U	59.6 U
m,p-Xylene (Sum of Isomers)	56.5 U	51.6 U	53.6 U	59.6 U
o-Xylene	56.5 U	51.6 U	53.6 U	59.6 U
Toluene	56.5 U	51.6 U	53.6 U	59.6 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>				
Acenaphthene	1.6 U	1.6 U	1.7 U	1.9 U
Acenaphthylene	1.6 U	1.6 U	1.7 U	1.9 U
Anthracene	1.6 U	1.6 U	1.7 U	1.9 U
Benzo(a)anthracene	1.6 U	1.6 U	1.7 U	1.9 U
Benzo(a)pyrene	1.6 U	1.6 U	1.7 U	1.9 U
Benzo(b)fluoranthene	1.6 U	1.6 U	1.7 U	1.9 U
Benzo(g,h,i)perylene	1.6 U	1.6 U	1.7 U	1.9 U
Benzo(k)fluoranthene	1.6 U	1.6 U	1.7 U	1.9 U
Chrysene	1.6 U	1.6 U	1.7 U	1.9 U
Dibenzo(a,h)anthracene	1.6 U	1.6 U	1.7 U	1.9 U
Fluoranthene	1.6 U	1.6 U	1.7 U	1.9 U
Fluorene	1.6 U	1.6 U	1.7 U	1.9 U
Indeno(1,2,3-cd)pyrene	1.6 U	1.6 U	1.7 U	1.9 U
Naphthalene	1.6 U	1.6 U	1.7 U	1.9 U
Phenanthrene	1.6 U	1.6 U	1.7 U	1.9 U
Pyrene	1.6 U	1.6 U	1.7 U	1.9 U
<b>Physical Parameters</b>				
Total Solids (percent)	89.8	97.4	95.2	84.3

**Key:**

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

Table 2-16 Lookout Pad Area Surface Soil Sample Analytical Results

Location ID: Depth (feet): Sample ID: Sample Date: Laboratory ID(s): Parameter	Surface Samples				
	LOPSL01	LOPSL02	LOPSL03	LOPSL04	LOPSL05
	16.0-16.5	17.0-17.5	3.0-3.5	20.0-20.5	25.0-25.5
	LOPSL01SO16.0N1	LOPSL02SO17.0N1	LOPSL03SO3.0N1	LOPSL04SO20.0N1	LOPSL05SO25.0N1
	6/30/00 1003587001	6/30/00 1003587002	6/30/00 1003587003	6/30/00 1003587004	6/30/00 1003587005
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>					
Gasoline Range Organics	2.60 U	2.71 U	2.63 U	2.62 U	2.89 U
Diesel Range Organics	130	105	1340	20.6 U	33.0
Residual Range Organics	16.5 U	125	60.5	--	--
<b>BTEX [8021B] (µg/kg)</b>					
Benzene	13.0 U	13.6 U	13.1 U	13.1 U	14.5 U
Ethylbenzene	52.0 U	54.3 U	52.6 U	52.4 U	57.9 U
m,p-Xylene (Sum of Isomers)	52.0 U	54.3 U	52.6 U	52.4 U	57.9 U
o-Xylene	52.0 U	54.3 U	52.6 U	52.4 U	57.9 U
Toluene	52.0 U	54.3 U	52.6 U	52.4 U	57.9 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>					
Acenaphthene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
Acenaphthylene	6.32	1.8 U	2.6 U	2.6 U	2.8 U
Anthracene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
Benzo(a)anthracene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
Benzo(a)pyrene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
Benzo(b)fluoranthene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
Benzo(g,h,i)perylene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
Benzo(k)fluoranthene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
Chrysene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
Dibenzo(a,h)anthracene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
Fluoranthene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
Fluorene	1.7 U	1.8 U	2.6 U	2.6 U	4.75
Indeno(1,2,3-cd)pyrene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
Naphthalene	1.7 U	26.0	2.6 U	2.6 U	75.8
Phenanthrene	2.77	3.78	2.6 U	2.6 U	6.33
Pyrene	1.7 U	1.8 U	2.6 U	2.6 U	2.8 U
<b>Physical Parameters</b>					
Total Solids (percent)	98.5	92.7	96.3	96.5	86.6

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.







surface soil samples collected from the bluff. DRO was detected in four samples ranging in concentration from 33 mg/kg (LOPSL05SO25.0) to 1,340 mg/kg (LOPSL03SO3.0). Four PAHs were detected in three samples: acenaphthylene was detected at 6.32 µg/kg; fluorene was detected at 4.75 µg/kg; naphthalene was detected in two samples ranging from 26.0 to 75.8 µg/kg; and phenanthrene was detected in three samples ranging from 2.77 to 6.33 µg/kg. Interpretation of the DRO/RRO chromatographs indicates that the hydrocarbons observed in the bluff face surface samples are weathered middle distillate products.

The near surface geotechnical sample collected at 2 feet bgs (LOPSL09SO2.0) was collected from the same geologic horizon as were the analytical samples that contained DRO (LOPSL03SO3.0 and LOPSL01SO1.0). The grain size analysis indicated that this horizon is composed of sandy silt and had a hydraulic conductivity of  $8.8 \times 10^{-5}$ . The grain size analysis for the sample collected in the water table (LOPWL02SO22.0) indicates that at this location the aquifer is comprised of silty sand with a hydraulic conductivity of  $3.7 \times 10^{-5}$ .

Groundwater samples were collected from the two LOP monitoring wells and were analyzed for GRO, BTEX, VOC, DRO, RRO, metals, and PAH. Table 2-17 summarizes the LOP groundwater sample analytical results. Arsenic, barium, chromium, and lead were the only analytes detected in the LOP groundwater samples.

Figure 2-13 is an oblique block diagram that illustrates the geology in the vicinity of LOP. The figure also shows the subsurface soil and bluff surface soil analytical results.

## **2.2.10 Ravine Area**

### **2.2.10.1 Physical Description**

The RVA is approximately 120 feet long and approximately 50 feet wide and opens out to Knik Arm. Figure 2-14 shows the RVA site features. At the west end of the ravine, there are the remains of a 10-foot-high retaining wall constructed of perforated steel plates, timbers, empty 55-gallon drums, and cotton tarps. The southern end of the drum wall was removed during the EE/CA field program to allow access and remove empty drums that had collapsed out of the retaining wall onto the bluff and beach. The remaining drums within the drum wall are situated such that they are stacked on their sides, 5 drums high by 16 drums long. Concrete steps were present leading from within the RVA to its top edge between the LOP and the DKA. To the east of the steps is a concrete footing, 3-feet by 3-feet by 3-feet in size. Additionally, an 8-inch diameter wire-wrapped wood stave pipe was exposed in the south wall of the ravine approximately 1 foot bgs and trended south toward the DKA.

Table 2-17 Lookout Pad Area Groundwater Sample Analytical Results

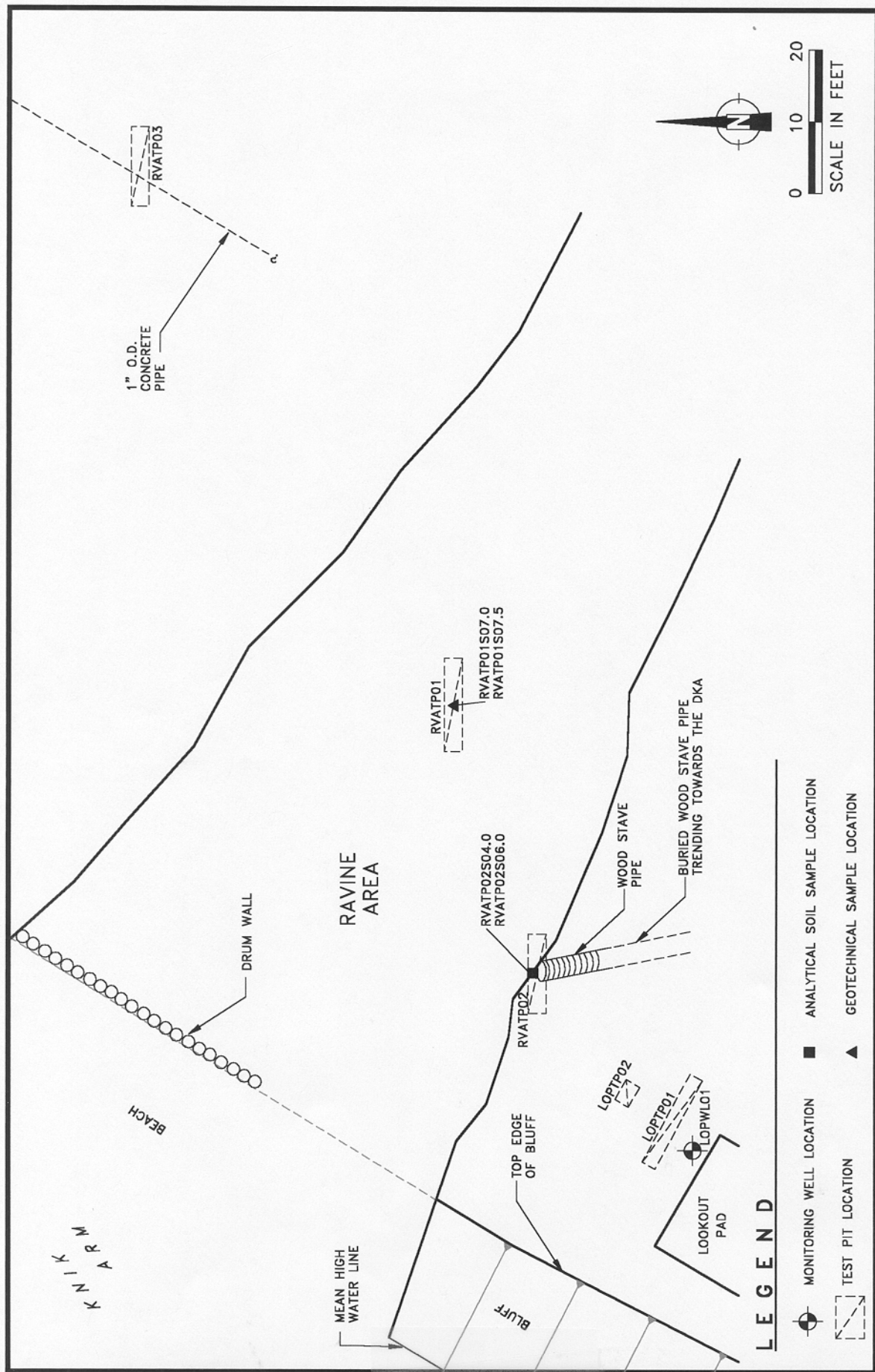
Parameter	Location ID:	LOPWL01		LOPWL02
	Sample ID:	LOPWL01WG01N1	LOPWL01WG01N2	LOPWL02WG02N1
	Sample Date:	7/12/00	8/9/00	7/12/00
	Sample QC Type:		Resample	
	Laboratory ID(s):	1003844004	1004455004	1003844005
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (µg/L)</b>				
Gasoline Range Organics		90.0 U	--	90.0 U
Diesel Range Organics		638 U	297 U	297 U
Residual Range Organics		1060 U	495 U	495 U
<b>BTEX [8021B] (µg/L)</b>				
Benzene		0.500 U	--	0.500 U
Ethylbenzene		2.00 U	--	2.00 U
m,p-Xylene (Sum of Isomers)		2.00 U	--	2.00 U
o-Xylene		2.00 U	--	2.00 U
Toluene		2.00 U	--	2.00 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/L)</b>				
Acenaphthene		0.051 U	--	0.051 U
Acenaphthylene		0.051 U	--	0.051 U
Anthracene		0.051 U	--	0.051 U
Benzo(a)anthracene		0.051 U	--	0.051 U
Benzo(a)pyrene		0.051 U	--	0.051 U
Benzo(b)fluoranthene		0.051 U	--	0.051 U
Benzo(g,h,i)perylene		0.051 U	--	0.051 U
Benzo(k)fluoranthene		0.051 U	--	0.051 U
Chrysene		0.051 U	--	0.051 U
Dibenzo(a,h)anthracene		0.051 U	--	0.051 U
Fluoranthene		0.051 U	--	0.051 U
Fluorene		0.051 U	--	0.051 U
Indeno(1,2,3-cd)pyrene		0.051 U	--	0.051 U
Naphthalene		0.051 U	--	0.051 U
Phenanthrene		0.051 U	--	0.051 U
Pyrene		0.051 U	--	0.051 U
<b>Volatile Organic Compounds [8260B] (µg/L) *</b>				
No volatile organic compounds were detected.				
<b>Metals [6000/7000] (µg/L)</b>				
Arsenic		5.56 U	--	9.11
Barium		104	--	338
Cadmium		0.556 U	--	0.556 U
Chromium		5.56 U	--	79.6
Lead		5.56 U	--	14.2
Mercury		0.200 U	--	0.200 U
Selenium		5.56 U	--	5.56 U
Silver		1.11 U	--	1.11 U

**Key:**

-- = Analysis not performed on this sample.

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.

\* No volatile organic compounds were detected; refer to Appendix H for complete listing.



3 CES/CEVR  
SS83 EE/CA  
ELMENDORF AFB, ALASKA  
ENSR PROJECT #9000-230

FIGURE 2-14  
RAVINE AREA  
TEST PIT SAMPLE LOCATIONS

DRAWING: RAVINE2  
C/SC: 1:1  
DATE: 5/22/01  
DRAWN: SSR  
ZIP: 44/00  
CHECK: J.DONLEY

### **2.2.10.2 Previous Investigation Results**

During the LFI (USAF 1999b), it was observed that an iron pipe protruding from the wall of the ravine was the appropriate size to have been used as a sewage outlet. Two hand borings were completed downslope of the pipe outfall and sampled to a depth of 3 feet bgs. There was no soil staining and no headspace readings above zero noted for either of the borings; therefore, no laboratory samples were collected. A metal detector was used in an attempt to identify the origin of the pipe, but no conclusive evidence was found due to the large amount of metal debris in the area. The pipe appeared to be associated with the DKA located to the southeast (USAF 1999b).

### **2.2.10.3 EE/CA Field Investigation Results**

Three test pits were excavated at the RVA. RVATP01 was excavated in the center of the RVA to determine the presence of any buried structures within the ravine and to collect a geotechnical sample at groundwater. Groundwater was encountered at 7 feet bgs in RVATP01, which was excavated to a total depth of 7.5 feet bgs. No debris and no fuel odors were encountered in RVATP01. RVATP02 was excavated beneath the wood stave pipe to assess the possibility that the pipe is a contaminant migration pathway. The geophysical survey results (Appendix A) suggest that this wood stave pipe extends toward the corridor area of the DKA at a shallow depth (estimated 2 feet bgs). Approximately 6 feet of the wood stave pipe was removed during excavation of RVATP02. A third test pit (RVATP03) was excavated northeast of the ravine to confirm the presence of buried metal debris and a buried north-south pipe as indicated by the preliminary geophysical survey results. A 1-foot diameter concrete pipe was excavated at 1 foot bgs in RVATP03. No metal debris was encountered.

### **2.2.10.4 Field Screening Results**

ATH field screening measurements recorded from soil excavated from RVA test pits ranged from 0.0 to 2.5 ppm. No fuel odor was detected in any RVA soils.

### **2.2.10.5 Laboratory Analytical Results**

Two subsurface soil samples were collected from RVATP01 for laboratory analysis. Samples were analyzed for GRO, BTEX, DRO, RRO, and PAH. No analytes were detected above method detection limits. Table 2-18 shows the RVA test pit sample results.

Two samples were collected from TP01 at two depths near the groundwater interface (RVATP01SO7.0 and RVATP01SO7.5). Geotechnical results indicate that the water table in the vicinity of RVA occurs in poorly graded gravel with sand that exhibits a hydraulic conductivity ranging from  $1.1 \times 10^{-2}$  to  $2.0 \times 10^{-3}$ .



Table 2-18 Ravine Area Soil Sample Analytical Results

Parameter	Test Pit Samples	
	RVATP02	
	4.0-5.0	6.0-7.0
	RVATP02SO4.0N1	RVATP02SO6.0N1
	6/22/00	6/22/00
Location ID:		
Depth (feet):		
Sample ID:		
Sample Date:		
Laboratory ID(s):	1003316003	1003316004
<b>Bulk Petroleum Hydrocarbons [AK101, AK102, AK103] (mg/kg)</b>		
Gasoline Range Organics	2.59 U	2.63 U
Diesel Range Organics	9.80 U	9.42 U
Residual Range Organics	16.2 U	15.5 U
<b>BTEX [8021B] (µg/kg)</b>		
Benzene	12.9 U	13.2 U
Ethylbenzene	51.8 U	52.7 U
m,p-Xylene (Sum of Isomers)	51.8 U	52.7 U
o-Xylene	51.8 U	52.7 U
Toluene	51.8 U	52.7 U
<b>Polycyclic Aromatic Hydrocarbons [8270C/SIM] (µg/kg)</b>		
Acenaphthene	1.7 U	1.5 U
Acenaphthylene	1.7 U	1.5 U
Anthracene	1.7 U	1.5 U
Benzo(a)anthracene	1.7 U	1.5 U
Benzo(a)pyrene	1.7 U	1.5 U
Benzo(b)fluoranthene	1.7 U	1.5 U
Benzo(g,h,i)perylene	1.7 U	1.5 U
Benzo(k)fluoranthene	1.7 U	1.5 U
Chrysene	1.7 U	1.5 U
Dibenzo(a,h)anthracene	1.7 U	1.5 U
Fluoranthene	1.7 U	1.5 U
Fluorene	1.7 U	1.5 U
Indeno(1,2,3-cd)pyrene	1.7 U	1.5 U
Naphthalene	1.7 U	1.5 U
Phenanthrene	1.7 U	1.5 U
Pyrene	1.7 U	1.5 U
<b>Physical Parameters</b>		
Total Solids (percent)	96.6	97.5

**Key:**

U = Parameter not detected above the method quantitation limit (MQL), value reported is the MQL.



## 2.3 Streamlined Risk Evaluation

The streamlined risk evaluation is considered intermediate in scope between the limited risk evaluation undertaken for emergency actions and the conventional baseline assessment normally conducted for remedial actions. This streamlined risk evaluation can help justify a removal action and identify what current or potential exposures should be prevented. The outline of the streamlined risk evaluation incorporates the systematic approach of a major risk assessment including planning and scoping tasks, problem formulation, and risk characterization. The purpose of the streamlined risk evaluation, conducted as part of the EE/CA process, is to provide specific information that influences the risk management options for the site. For the SS83 EE/CA process, the streamlined risk evaluation estimates the potential risk of human health problems occurring if no cleanup action is taken at a site. Potential ecological risks are also evaluated under the assumption that no cleanup action will be taken at the site.

In recent years, EPA's risk assessment emphasis has shifted increasingly to a more broad-based approach characterized by greater consideration of multiple endpoints, sources, pathways, and routes of exposure; community-based decision-making; flexibility in achieving goals; and site-specific responses. This more complex assessment involves the evaluation of cumulative site risk. It is defined in each case according to who or what is at risk of adverse effects—from identifiable sources and stressors—through several routes of exposure over varied time frames. ADEC's CSRP provides a similar basis for evaluating risk to human health and the environment at contaminated sites. The ADEC framework focuses on technical information related to the sources, effects, populations, and the routes of exposure. ADEC developed its risk evaluation framework using the methodology presented in the EPA's Soil Screening Guidance: User's Guide (EPA 1996) and other EPA risk assessment guidance. These EPA guidance documents present equations and default parameters used to calculate numerical cleanup levels that are protective of human health, based on exposure to a hazardous substance and the toxicity of that hazardous substance. Using these equations, the streamlined risk evaluation presented below estimates cumulative carcinogenic risk and noncarcinogenic hazard index for the SS83 site. According to ADEC, cumulative risk is defined as the sum of risks resulting from multiple sources and pathways to which humans are exposed. When more than one hazardous substance is present at a site or multiple exposure pathways exist, the cumulative cancer risk remaining at the site when cleanup is completed must be equal to or less than 1 in 100,000 and the cumulative noncarcinogenic hazard index (HI) must be equal to or less than 1.0.

Based on a site's cumulative risk, ADEC determines the necessity for and degree of cleanup required to protect human health, safety, and welfare and the environment at contaminated sites under the CSRP. If applying soil cleanup levels under Methods Two or Three or applying groundwater cleanup levels, a responsible party must ensure that cumulative carcinogenic risk and hazard thresholds are not exceeded.

This section has been prepared to ensure that cumulative risks associated with estimated human exposures to chemicals of potential concern (COPCs) identified at the SS83 site do not exceed risk management thresholds established by ADEC. The objective is to ensure that the risk-based cleanup levels used to characterize the site are protective of human health, given the site-specific nature of contaminants and exposure pathways. Since this risk evaluation is being conducted as part of an EE/CA, consideration is given to site-specific conditions; land use; hazardous substance characterizations; regulatory compliance; protection of human health, safety, and welfare and the environment; cleanup implementability; long-term and short-term effectiveness; use of treatment technologies; public comment; and cost. Results of the risk evaluation will be used in Sections 3.0 and 4.0 to establish removal action objectives and evaluate removal action alternatives for the 10 SS83 areas of investigation.

The streamlined risk evaluation was conducted in a stepwise manner using methods identified in ADEC's Risk Assessment Procedures Manual (2000c) and Guidance on Cleanup Standards Equations and Input Parameters (ADEC 2000d). Where information is limited, risk estimates were developed in a conservative manner that likely overestimates the actual risk.

The streamlined risk evaluation is subject to uncertainty resulting from site-specific sources and risk estimation procedures in general. Uncertainties associated with sampling and analysis include the inherent variability in the analysis, representativeness of the samples, sampling errors, and heterogeneity of the sample matrix. While the SS83 Sampling and Analysis Plan served to reduce these errors, such work plans cannot eliminate all errors associated with sampling and analysis. The streamlined risk evaluation also makes simplifying assumptions about the environmental fate and transport of site contaminants; specifically, that chemical concentrations will not change in time. For example, a source of potential error is the choice of data used to represent exposure concentrations. Additional assumptions regarding the frequency and duration of exposure and the relationship between chemical toxicity and exposure tend to simplify and approximate site conditions. The use of generic overly-conservative screening levels for ecological receptors also introduces uncertainty into the risk evaluation process. Given these sources of uncertainty, it should be noted that the streamlined risk evaluation results are only estimates and should be interpreted in light of the assumptions required to quantify the cumulative site risk. However, where information is limited, risk estimates were developed in a conservative manner that likely overestimates the actual risk.

### **2.3.1 Risk Management Criteria**

ADEC risk management criteria regarding cumulative carcinogenic and noncarcinogenic site risks must not be exceeded when applying risk-based soil cleanup levels or applying groundwater cleanup levels from Table C. When more than one hazardous substance is present at a site or multiple exposure pathways exist, the Table B1 soil or Table C groundwater cleanup levels for a particular substance may be reduced so that the estimated cumulative site risk or hazard index is below the appropriate risk management standard.

According to 18 AAC 75.325 (g), the risk from hazardous substances remaining after site cleanup cannot exceed a cumulative carcinogenic risk of 1 in 100,000 (i.e.,  $1 \times 10^{-5}$ ) for all completed exposure pathways and a cumulative noncarcinogenic risk threshold (i.e., hazard index) of 1.0 for each exposure pathway. A carcinogenic risk level of  $1 \times 10^{-5}$  represents a probability of one in one-hundred-thousand that an individual could develop cancer as a result of exposure to carcinogens under a defined set of exposure assumptions. If the estimated cumulative carcinogenic risk falls below this level, the site is considered unlikely to pose an unacceptable cancer health risk to individuals under the given exposure conditions. If cumulative noncarcinogenic risks fall below a hazard index of 1.0, the site is considered unlikely to pose an unacceptable health hazard to individuals under the given exposure conditions.

Contaminants are generally divided into two basic groups, those that have a cancer endpoint and those that do not have a cancer endpoint. Cumulative carcinogenic risk and noncarcinogenic hazard index are calculated separately. However, some compounds can cause both endpoints and are included in both cumulative risk calculations. The cumulative carcinogenic risk remaining at a site after cleanup must be equal to or less than the risk management level of 1 in 100,000 ( $1 \times 10^{-5}$ ); cumulative carcinogenic risk is defined as the sum of cancer risks resulting from multiple chemical sources, and pathways to which humans are exposed. Cancer risks resulting from exposure to two or more carcinogens are assumed to be additive and without synergistic or antagonistic chemical interactions.

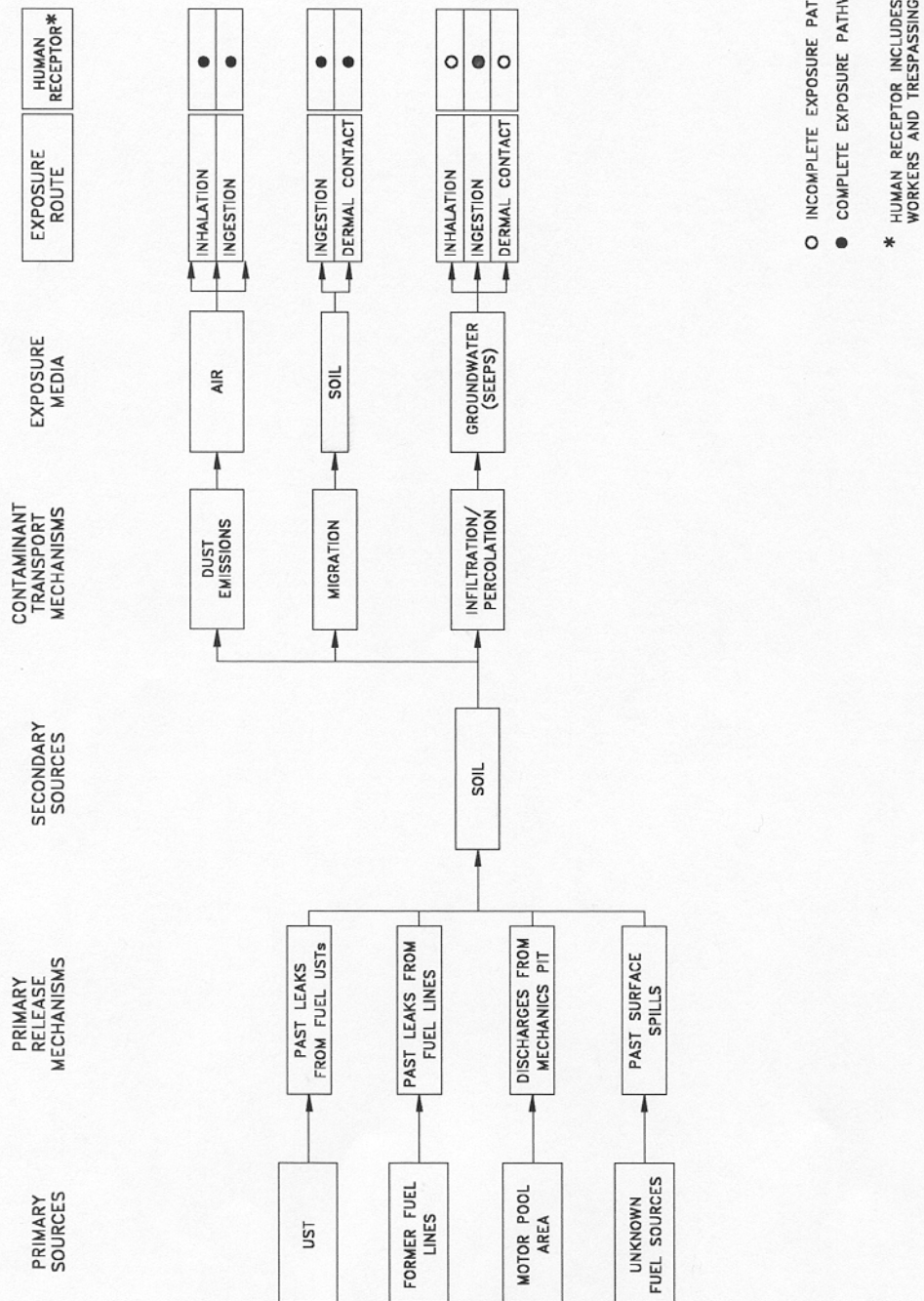
The cumulative noncarcinogenic HI must be equal to or less than the risk management level of 1.0; the cumulative noncancer HI is defined as the sum of compound-specific hazard quotients (HQ) across all pathways that affect the same target organ or physiological endpoint. ADEC defines a noncarcinogen as a hazardous substance with adverse effects on humans other than cancer. The HQ represents the ratio of estimated intake of a compound to the estimated intake at which there are no observed adverse effects. For noncarcinogens, the health threat resulting from exposure to two or more hazardous substances with similar types of toxic responses are assumed to be additive. However, because the mechanism of toxicity associated with chemical mixtures is poorly understood, this assumption may not be appropriate.

Table C groundwater cleanup levels are also assumed to be protective of the human ingestion of groundwater. Table C values were developed using EPA's maximum contaminant levels (MCLs), maximum contaminant level goals (MCLGs), or health-based limits (HBLs). HBLs are based on toxicological data and risk to human health.

The components of the streamlined risk evaluation process are described below.

### **2.3.2 Conceptual Site Model**

A conceptual site model (CSM) is a way of presenting all potentially complete exposure pathways in an understandable format. The CSM for the SS83 site is shown on Figure 2-15. The CSM shows completed exposure pathways that require evaluation. Included in this CSM are the identified sources of contamination, release/transport mechanisms, affected



3 CES/CEVR  
SS83 EE/CA  
ELMENDORF AFB, ALASKA  
ENSR PROJECT #9000-230

FIGURE 2-15  
CONCEPTUAL SITE MODEL

DRAWN: SSR  
ZIP: 44/00  
CHECK: E.W.

DRAWING: CSM  
C/SC: 1:1  
DATE: 01/17/01

environmental media (e.g., surface soil, groundwater), exposure routes (i.e., ingestion, inhalation, or dermal contact), and possible human receptors (e.g., workers and trespassers). The SS83 EE/CA does not consider ecological exposures, but there are no critical habitats or protected ecological receptors identified within the SS83 site. Off-base receptors are also not considered.

The level of risk is dependent on the degree to which people are exposed, which is influenced by the types and duration of activities conducted at the site. The land-use at the site is strictly military/industrial. There are no residences nearby, and the most highly exposed human receptors that may come in physical contact with site-related contaminants are military/industrial workers. According to the Management Action Plan (USAF 1996), the future projected land use at this site will not be different from the current land use. Therefore, as illustrated in the CSM, the potential human receptor identified for this site is an industrial worker exposed through incidental ingestion of soil and inhalation of volatilized soil constituents in air. As such, exposure pathways for a site trespasser are highly conservative and unlikely, particularly based on the security measures in place at the site.

Based on the CSM, the possible exposure pathways identified for the SS83 site are incidental ingestion (including dermal contact) and inhalation of volatile chemicals. There is no exposure to chemicals in subsurface soil unless excavation activities expose materials at the site. Subsurface soil samples were nevertheless included in this streamlined risk evaluation in order to account for hypothetical excavation activities. The groundwater exposure pathway is complete when it is assumed that groundwater is a future drinking water source. Groundwater at the site is not currently a source of drinking water. Well #30 (located upgradient of the site) is reportedly capped and could not be located during the 2000 field investigation.

The following subsections are presented to demonstrate that the cleanup levels used to characterize the site are protective of the human exposure scenarios identified in the CSM.

### **2.3.2.1 Risk-Based Cleanup Levels**

Method Two chemical-specific (e.g., BTEX, PAHs, and metals) and bulk petroleum hydrocarbon (e.g., GRO, DRO, and RRO) soil cleanup levels are organized in Tables B1 and B2, respectively, according to contaminant exposure pathways and the amount of precipitation a site receives per year (18 AAC 75.340; ADEC 2000a). Groundwater cleanup levels are established in Table C. ADEC Method Two soil cleanup levels were developed to account for the following human exposure routes: ingestion of soil (including ingestion of fugitive dust and dermal exposure to soil), inhalation of volatilized constituents from soil to ambient air, and ingestion of groundwater. Risk-based concentrations (RBCs), specific to carcinogenic and noncarcinogenic endpoints, are used to develop the compound-specific risk-based cleanup levels that correspond to the concentrations of a hazardous substance in soil or groundwater above which an adverse toxicological effect would likely result. The levels are calculated using soil/aquifer data as well as toxicological data specific to the compound of interest (ADEC



2000b). If a compound is both carcinogenic and noncarcinogenic, the cleanup level is developed based on the lowest concentration causing an effect.

The inhalation, ingestion, and migration-to-groundwater soil cleanup levels, specific to the Under 40-inch Zone, are used as cleanup goals for this site. These cleanup levels are based on an exposure frequency of 270 days per year under a residential exposure scenario not reasonably anticipated for the site (ADEC 2000a). The chemical-specific cleanup levels are concentrations below which risk is considered to be negligible based on conservative residential exposure pathway assumptions. Compounds not meeting Method Two cleanup levels and determined to be outside the range of naturally occurring concentrations were targeted for further risk evaluation.

As described previously, groundwater occurs in an unconfined aquifer composed of outwash deposits above Bootlegger Cove clay. As indicated in test pit and boring logs and through geotechnical analyses, soil contaminants localized within the unsaturated zone may migrate to groundwater. Analytical soil data was compared to Method Two migration-to-groundwater soil cleanup levels. The results of this comparison identified several sample locations at which petroleum concentrations in soil were detected in excess of Method Two migration-to-groundwater cleanup levels for BTEX constituents (see Table 2-1) or bulk petroleum hydrocarbons (e.g., 250 mg/kg DRO, 11,000 mg/kg RRO), as outlined below:

- At the DBA, in a surface sample collected approximately 1 foot bgs in test pit DBATP01 (6,480 mg/kg DRO).
- At the LFA, in a sample collected from the surface near Tank 1 (3,000 mg/kg DRO) and at 15 to 17 feet bgs (405 mg/kg DRO; LFAWL01) downgradient of Tank 1 and at 10 to 11 feet bgs downgradient of Tank 2 (550 and 678 mg/kg DRO).
- At the MPA, in samples collected between 5 to 6 feet bgs from test pit MPATP01 (1,070 mg/kg DRO, up to 94,000 mg/kg RRO, and 2,400 mg/kg BTEX) excavated within the mechanic's pit and probably in soils up to 12 to 14 feet bgs remaining after the excavation.
- At the SFA, in a sample collected from approximately 2.5 to 3.5 feet bgs in soil boring SFAWL03 (4,110 mg/kg DRO).
- At the BBA, in samples collected from 5 to 17 feet bgs at test pit BBATP06 (5,230 mg/kg DRO) and soil boring BBAWL01 (between 268 to 3,730 mg/kg DRO).
- At the LOP, in samples collected from 1 to 3.5 feet bgs in soil boring LOPWL01 (20,400 mg/kg) and surface sample LOPSL03 (1,340 mg/kg).

Except for one sample collected at MPATP01 and one sample collected at LOPWL01, neither DRO nor any other compound was detected above Method Two ingestion- or inhalation-specific soil cleanup levels.

Analytical groundwater data was compared to ADEC Table C groundwater cleanup levels. All Table C groundwater cleanup levels are expected to be protective of the ingestion of groundwater. The results of this comparison identified a few sample locations at which petroleum or metals concentrations were detected in excess of Table C values (see Table 2-1), as outlined below:

- At the LFA, chromium and lead (136 µg/L and 30.1 µg/L, respectively) were detected above cleanup levels (100 and 15 µg/L, respectively) in the sample collected from monitoring well LFAWL02.
- At the MPA, chromium was detected (126 µg/L) above the cleanup level in the sample collected from MPAWL03, and lead was detected (42.9 and 22.2 µg/L) above the cleanup level in samples collected from MPAWL03 and MPAWL04.
- At the BBA, DRO was detected in the sample collected at BBAWL01 at 1,450 µg/L (and 2,410 µg/L in the field duplicate) above the cleanup level of 1,500 µg/L, and arsenic, chromium, and lead were detected (109 µg/L, 181 µg/L, and 43.9 µg/L, respectively) above cleanup levels in the sample collected at BBAWL02.
- At the SFA, arsenic, chromium, lead, and mercury cleanup levels were exceeded in the sample collected at SFAWL01; all metals except selenium and silver were exceeded in SFAWL02, and lead was exceeded in SFAWL03 and SFAWL04.

Analytical groundwater data for metals were also compared to Basewide background concentrations (discussed previously in Section 1.6.2). These background concentrations are considered to be representative of the metals concentrations that would be expected in uncontaminated groundwater in the EAFB area. According to ADEC, if a chemical found at a site is shown to be solely attributable to the background concentration, then the chemical is not retained for further risk evaluation. Except for the elevated levels of arsenic, chromium, and mercury in two wells at the SFA, the metals in excess of ADEC groundwater cleanup levels are within naturally occurring levels for the EAFB area.

### **2.3.3 Risk-Based Screening**

In addition to comparing analytical results to risk-based cleanup levels, site environmental concentrations must be evaluated to verify that cumulative site risks do not exceed ADEC risk management thresholds.

The first step in calculating cumulative site risk is to evaluate the highest site concentration for each hazardous substance detected against risk-based screening levels. For specific chemicals

detected in soil, risk-based screening concentrations have been adopted by ADEC as one-tenth the cleanup levels given in Tables B1 and B2 of 18 AAC 75. Similarly, the initial screening concentrations for groundwater are established by ADEC at one-tenth the cleanup levels in Table C. However, certain Table C values (e.g., arsenic) were developed using EPA's MCLs that are based on factors (e.g., feasibility and cost) in addition to health. According to ADEC, all Table C groundwater cleanup levels can be considered to protect against adverse effects associated with the ingestion of groundwater. Therefore, for individual compounds except those based on MCLs (arsenic), Table C cleanup levels are established at a carcinogenic risk standard of  $1 \times 10^{-6}$  and a noncarcinogenic hazard quotient of 0.1. One-tenth of these values were used as risk-based screening criteria to identify groundwater COPCs (i.e., benzene, barium, cadmium) at this site. For arsenic, the Table C cleanup level (0.05 mg/L) is associated with a cancer risk ( $8.8 \times 10^{-4}$ ) and HQ (4.6) in excess of ADEC risk management criteria.

The screening process is conducted in order to develop a set of COPCs (see Table 2-19) consistent with both EPA and ADEC guidelines. Each COPC must be included in cumulative site risk calculations. As discussed above, inorganic COPCs determined to be within background or naturally occurring ranges are not included in the cumulative risk calculations (ADEC 1998a).

For sites where impacted groundwater is a reasonably expected future source of drinking water, a chemical detected at one-tenth or more of the Table C value must also be included when calculating cumulative risk. DRO was detected in only one well (BBAWL01) at a reported level of 2.41 mg/L in the field duplicate sample (1.45 mg/L for the primary sample) – above Table C cleanup levels. Very low levels of benzene (1.2 to 2.0 µg/L), below the Table C cleanup level of 5 µg/L but above the one-tenth screening level, were detected in only two wells (SFAWL02 and SFAWL03) located downgradient from the bermed bunker and small foundation areas. The only petroleum hydrocarbon constituent detected above one-tenth of Table C values is benzene. All other petroleum hydrocarbon indicator compounds are below screening levels. The only metals detected above one-tenth of Table C are arsenic, barium, cadmium, chromium, and mercury.

#### **2.3.4 Cumulative Risk**

Soil and groundwater concentrations of bulk petroleum hydrocarbons (e.g., RRO and DRO) at this site were not included in risk screening or cumulative risk estimates because the toxicity associated with weathered hydrocarbon ranges is poorly quantified. However, the carcinogenic risk of petroleum was adequately evaluated by determining the risk from indicator compounds such as benzene and the carcinogenic PAHs. Similarly, the noncarcinogenic risk of petroleum was adequately evaluated by determining the HI for the volatile constituents toluene, ethylbenzene, and xylenes and the noncarcinogenic PAHs in soil (as identified in Table 2-19). The highest soil and groundwater concentrations from the 2000 EE/CA field investigation for the more hazardous constituents (PAH and BTEX) were used to estimate carcinogenic and

Table 2-19. SS83 EE/CA Streamlined Risk Evaluation - Cumulative Site Risk -Soil.

	Risk-Based Screening Level*	Maximum Reported Soil Concentration †	Compound of Potential Concern	Soil Ingestion Cleanup Level	Soil Inhalation Cleanup Level	Cancer Risk (Ingestion)	Cancer Risk (Inhalation)	Non-Cancer Hazard Quotient (Ingestion)	Non-Cancer Hazard Quotient (Inhalation)
BTEX mg/Kg									
Benzene	0.9	ND	No	290	9	1.6E-10	5.2E-09	Hazard not considered.	
Ethylbenzene	8.9	ND	No	10000	89	Compound is not carcinogenic.	Compound is not carcinogenic.	0.00	0.00
Toluene	18.0	0.066	No	27400	180			0.00	0.00
Xylenes	8.1	0.074	No	274000	81			0.00	0.00
Polycyclic Aromatic Hydrocarbons (PAHs) mg/Kg									
Carcinogenic PAHs									
Benzo(a)anthracene	1.1	ND	No	11	na	2E-08 \$	Pathway is incomplete. Compound is not volatile.	0.00 ‡\$	Pathway is incomplete. Compound is not volatile.
Benzo(a)pyrene	0.10	0.0019	No	1	na	1.9E-08 \$		0.00 ‡	
Benzo(b)fluoranthene	1.10	ND	No	11	na	3E-08 \$		0.00 ‡\$	
Benzo(k)fluoranthene	11	ND	No	110	na	8.1E-09 \$		0.00 ‡\$	
Chrysene	110	0.0119	No	1100	na	1.1E-10		0.00 ‡	
Dibenzo(a,h)anthracene	0.10	ND	No	1	na	3.9E-07 \$		0.00 ‡\$	
Indeno(1,2,3-cd)pyrene	1.1	ND	No	11	na	1.3E-07 \$		0.00 ‡\$	
Non-carcinogenic PAHs									
Acenaphthene	610	ND	No	6100	na			0.00	
Acenaphthylene#	410	ND	No	4100	na			0.00	
Anthracene	3000	ND	No	30000	na			0.00	
Benzo(g,h,i)perylene#	410	ND	No	4100	na	Pathway is incomplete. Compound is not carcinogenic.	Pathway is incomplete. Compound is not carcinogenic.	0.00	Pathway is incomplete. Compound is not volatile.
Fluoranthene	410	ND	No	4100	na			0.00	
Fluorene	410	ND	No	4100	na			0.00	
Naphthalene	410	0.0758	No	4100	na			0.00	
Phenanthrene#	410	0.0224	No	4100	na			0.00	
Pyrene	410	ND	No	4100	na			0.00	
Cumulative Pathway Cancer Risk									
						6E-07	5E-09		
Cumulative Site Cancer Risk									
						6E-07			
Cumulative Site Hazard Index								0.0	0.0

**Key:**

na = No available cleanup level.

ND = Analyte not detected (1/2 the highest method detection limit used for risk estimation).

**Notes:**

\*Risk-based screening level calculated at 1/10 most stringent ADEC Method Two, Under 40-inch Zone, Soil Cleanup Level.

†Maximum concentration reported for surface or subsurface soil during 2000 EE/CA field investigation.

‡In the absence of established non-carcinogenic toxicity criteria, the Method Two, Under 40-inch Zone, Ingestion Cleanup Level for pyrene is substituted.

§Compound not detected, risk estimated using 1/2 the highest method detection limit.

¶In the absence of established risk-based levels, the Method Two, Under 40-inch Zone, Ingestion Cleanup Level for pyrene is substituted.

noncarcinogenic risks. This approach reduces the uncertainty associated with the exclusion of bulk petroleum hydrocarbon data.

As described in Section 1.6, previous investigations have been conducted to determine the distribution of naturally occurring levels of inorganic compounds (metals) on EAFB. Summary statistics were applied to these results so that analytical results obtained from other Base investigations could be compared to the background levels (USAF 1993). Based on a comparison to these established background levels, only lead should be retained for further evaluation. However, lead is not included in cumulative site risk estimates because the lead cleanup level is not based on ADEC risk management criteria. Instead, Method Two lead cleanup levels are based on standardized modeling results obtained from the EPA's Integrated Exposure Uptake Biokinetic model. This model uses fate and transport factors and lead exposure and toxicity information (including maternal transfer) to calculate site concentrations that protect against adverse blood lead levels in children. At the SS83 site, a slightly elevated level of lead (14.1 mg/kg) was measured beneath the mechanic's pit at the MPA. Although this result is considered greater than background, the concentration is well below the Method Two cleanup levels for residential land use (400 mg/kg) and industrial land use (1,000 mg/kg).

Based on the history of site operations, previous investigation data, and the risk-based screening criteria, only benzene and certain metals were identified as COPCs at the SS83 site. Compounds that do not exceed their respective risk-based screening criteria ( $1 \times 10^{-6}$  cancer risk and/or hazard quotient = 0.1) should be eliminated from risk estimates. However, in an effort to provide verification that excess health risks are not present at this site, risk estimations were calculated for all petroleum hydrocarbon indicator compounds that have been detected in soil, even if they did not exceed their risk-based screening criteria. The highest site concentrations from the 2000 surface and subsurface soil samples were selected for estimating risk.

Summaries of all incremental risks associated with ingestion and inhalation exposure to BTEX, PAHs, and metals in soil are provided in Table 2-19. Included are the maximum detected concentrations from the 2000 field investigation, risk-based screening criteria, and cancer and noncancer risk estimations associated with the specific compounds. Risk estimates were obtained using Method Two Under 40-inch Zone risk-based cleanup levels, the maximum detected site concentrations, and an assumed additive risk from ingestion and inhalation exposures. In addition, for those petroleum hydrocarbon indicator compounds not detected above method quantitation limits, one-half the highest reported method detection limit was used to estimate risk.

The cumulative carcinogenic risk attributable to ingestion of contaminated site soil is  $6 \times 10^{-7}$  and to inhalation of volatilized soil constituents is  $5 \times 10^{-9}$ . Therefore, the cumulative site carcinogenic risk is estimated to be  $6 \times 10^{-7}$ . These risk values are less than the ADEC cancer risk threshold and are therefore considered negligible. For groundwater, incorporating a conservative assumption that benzene will not remain on site at levels greater than 5 µg/L, the



carcinogenic risk associated with the consumption of benzene and total metals (including arsenic) at maximum site concentrations through the groundwater pathway is  $7 \times 10^{-5}$  (see Table 2-20). This cancer risk is slightly greater than the ADEC threshold. However, when arsenic is not included in the estimation, the value ( $4.0 \times 10^{-6}$ ) is less than the ADEC cancer risk threshold and therefore considered negligible. For compounds such as arsenic that are based on EPA MCLs, the ADEC decides whether to set cleanup levels at Table C values or at lower values that correspond to less than or equal to the cumulative risk standards (ADEC 2000e).

For the noncarcinogenic endpoints, the estimated site hazard index for soil is 0.0 for ingestion pathways and 0.0 for inhalation pathways. These values do not exceed the ADEC noncarcinogenic risk threshold. The cumulative hazards associated with the ingestion of groundwater containing metals concentrations as measured at monitoring wells SFAWL01 and SFAWL02 are above ADEC risk thresholds. These concentrations may be attributable to background concentrations, but not definitively, given the limited nature of background groundwater quality for that portion of EAFB north of the Elmendorf Moraine. In addition, the collection of filtered samples would provide a better indication of the bioavailable fraction of metals assuming a drinking water scenario. Groundwater is not currently used as a drinking water source at the SS83 site.

The petroleum hydrocarbon contaminant concentrations on site do not exceed cumulative risk management thresholds; therefore, the Method Two soil and groundwater cleanup levels are appropriate for the SS83 site.

### **2.3.5 Potential Ecological Risks**

According to the ADEC risk assessment guidelines (ADEC 2000), ecological exposures can only be evaluated using a full risk assessment conducted under Method Four. A full (baseline) human health or ecological risk assessment is outside the purpose of this EE/CA, which is to develop and evaluate cleanup options for the SS83 site. However, in order to ensure that potential ecological risks are not overlooked and to support final site closure activities, this section provides a risk-based screening for COPEC consistent with EPA guidance (EPA 1999). The goal of the screening approach is to evaluate potential adverse effects to the terrestrial ecosystem associated with soil contamination at the SS83 site.

As shown in the CSM, ecological receptors at the SS83 site may be exposed to contaminants in much the same way as human receptors. Because plants and animals may live their entire life in one area, their potential exposure is likely to be greater than humans. Wildlife may be exposed to petroleum hydrocarbon contaminants from the ingestion or dermal contact with contaminated surface soil as well as the inhalation of fugitive dust and volatiles in ambient air. High levels of metals were present in soils located within the former mechanic's pit at the MPA; however, these soils were removed to a depth of approximately 10 feet bgs as a result of

Table 2-20. SS83 EE/CA Streamlined Risk Evaluation - Cumulative Site Risk -Groundwater.

	Risk-Based Screening Level*	Maximum Reported Groundwater Concentration †	Compound of Potential Concern	Groundwater Ingestion Cleanup Level	Cancer Risk (Ingestion)	Non-Cancer Hazard Quotient (Ingestion)
<b>BTEX <math>\mu\text{g/L}</math></b>						
Benzene	0.5	2.0	Yes	5	4E-06	Hazard not considered.
<b>Metals <math>\mu\text{g/L}</math></b>						
Arsenic	5	351	Yes	50	7.E-05 Risk not considered.	7.02
Barium	200	2230	Yes	2000	Risk not considered.	1.12
Cadmium	0.5	5.44	Yes	5	Risk not considered.	1.09
Chromium	10	1010	Yes	100	Risk not considered.	10.10
Mercury	0.2	13.9	Yes	2	Risk not considered.	6.95
Cumulative Site Cancer Risk					7E-05	
Cumulative Site Hazard Index						26.3

**Notes:**

\*Risk-based screening level calculated at 1/10 ADEC Table C Groundwater Cleanup Level.

†Maximum concentration reported for groundwater during 2000 EE/CA field investigation.

investigation activities. Therefore, petroleum hydrocarbons are the only surface soil contaminants remaining on site that may pose a potential risk to ecological receptors.

As described in Section 2.2, surface soil contamination at the SS83 site is limited to two areas: the SFA and the LOP. The SFA surface contamination is presumed to result from historical surface releases originating at the pad and extending approximately 50 feet to the northwest. One soil sample was collected from the surface interval (2.5 to 3.5 feet bgs) at SFAWL03 – located within the approximate center of the release. As shown in Figure 2-9, the sample results obtained from this location should adequately represent the surface soil contamination within the area. Analytical results indicate that the surface contamination is specific to diesel range hydrocarbons (4,110 mg/kg DRO); BTEX constituents were not detected, but certain PAHs were detected (e.g., 1.90 µg/kg benzo(a)pyrene). The LOP surface contamination is presumed to result from historical surface and subsurface releases originating at the LOP and extending toward the bluff. Due to bluff erosion, the LOP is now only a few feet from the edge of the pad; contaminated subsurface soil in the area has become exposed at the face of the bluff as erosion has occurred. Five surface soil samples (approximately 0.5 to 1 foot deep) were collected from the bluff face as shown in Figure 2-13. Analytical results indicate that the surface contamination is also specific to diesel range hydrocarbons (ranging from not detected to 1,340 mg/kg DRO); BTEX constituents were not detected, but certain PAHs were detected (e.g., 75.8 µg/kg naphthalene).

Diesel fuel (fuel oil No. 2D) is a complex mixture of hydrocarbons that are moderately mobile and persistent in most surface soil matrices. The ecotoxicological characteristics of heavy bulk petroleum hydrocarbons (DRO and RRO) are poorly understood. As discussed in Section 2.3.4, the potential for adverse effects from petroleum can be more adequately estimated by focusing evaluations on indicator compounds such as PAHs. Therefore, available soil screening levels (EPA 2000) were used to compare against the PAH concentrations reported for surface soil samples collected at the SFA and LOP.

However, few generally accepted ecologically-based soil screening levels are available. Ecological soil screening levels (Eco-SSLs) for plants, soil invertebrates, and wildlife (birds and mammals) are currently being derived by an EPA work group from existing soil screening benchmarks, acceptable ecotoxicity data, and generic food-chain models (EPA 2000). The derivation of Eco-SSLs is specific to several organic and inorganic contaminants of historical ecological concern. The derivation of Eco-SSLs for PAHs is still in progress. As part of the EPA's effort to derive Eco-SSLs, existing soil screening benchmarks specific to PAHs (primarily from Canadian efforts and the Oak Ridge National Laboratory) were compiled and evaluated (API 2000). These soil screening levels, provided in Table 2-21, are generic values derived using both human and/or ecological health effect endpoints under residential or industrial land use categories. They are not cleanup levels. Whether or not a contaminant poses a potential risk of adverse effects to ecological receptors actually depends upon site-specific factors. As a conservative screening approach, however, if a contaminant concentration is above the screening level, it should be considered a COPEC and targeted for further evaluation.

**Table 2-21. Comparison of Detected PAH Surface Soil Concentrations to Ecological Screening Criteria.**

Parameter	Ecological Soil Screening Level *		Source †	Maximum Reported Concentration in Surface Soil ‡	Sample No.	Sample Depth (feet)	COPEC?
	Residential Scenario	Industrial Scenario					
Polycyclic Aromatic Hydrocarbons (µg/kg)							
Acenaphthylene	100	100	MOEE	6.32	LOPSL01SO16.0N1	0.5 - 1.0	No
Anthracene	28	28	MOEE	15.7	SFAWL03DC2.5N1	2.5 - 3.5	No
Benzo(a)pyrene	0.7	1.2, 1.9	CCME, MOEE	1.90	SFAWL03DC2.5N1	2.5 - 3.5	No
Benzo(g,h,i)perylene	40	40	MOEE	2.62	SFAWL03DC2.5N1	2.5 - 3.5	No
Chrysene	12	17	MOEE	9.13	SFAWL03DC2.5N1	2.5 - 3.5	No
Fluoranthene	40	40	MOEE	4.87	SFAWL03DC2.5N1	2.5 - 3.5	No
Fluorene	30	340	ORNL-E, MOEE	4.75	LOPSL05SO25.0N1	0.5 - 1.0	No
Naphthalene	0.6, 4.6, 5	22, 4.6, 50	CCME, MOEE, BCME	75.8	LOPSL05SO25.0N1	0.5 - 1.0	Yes
Phenanthrene	5, 5, 40	50, 50, 40	BCME, CCME, MOEE	22.4	SFAWL03DC2.5N1	2.5 - 3.5	No

**Notes:**

\* Many soil screening levels have not undergone peer review; BCME and CCME screening levels both underwent considerable scientific and public review (API 1999).

† Screening levels compiled (API 1999) as part of EPA efforts to derive nationwide ecological soil screening levels (EPA 2000).

‡ Maximum reported concentration in surface soil (less than three feet deep) during 2000 EE/CA field investigation at the SFA and the LOP.

**Key:**

BCME = British Columbia Ministry of the Environment

CCME = Canadian Council of Ministers of the Environment

COPEC = Contaminant of Potential Ecological Concern.

MOEE = Ontario Ministry of Environment and Energy

ORNL-E = Oak Ridge National Laboratory, Oak Ridge, Tennessee; screening level specific to earthworms.

The highest PAH concentrations at the SFA or the LOP, measured in surface soils (less than 3 feet), were compared to a list of PAH-specific soil screening levels based on either residential or industrial exposure scenarios. Subsurface soils (greater than 3 feet) were not evaluated because ecological exposures to these soils would be minimal. As shown in Table 2-21, nine PAHs were detected in surface soils at the SS83 site. The concentrations of benzo(a)pyrene (1.9 µg/kg) and phenanthrene (22.4 µg/kg), reported for the sample collected at the SFA, exceeds the residential scenario screening levels (0.7 µg/kg and 5 µg/kg, respectively). The reported levels for these PAHs do not exceed the associated commercial or industrial screening levels. The difference between screening levels is due to the difference in receptors and exposure pathways for a given land use (API 1999). Ecological soil screening is initially conducted assuming the most conservative exposure scenarios (residential); however, the current and future land use at the SS83 site is military/industrial. Therefore, benzo(a)pyrene and phenanthrene are not selected as COPECs. Naphthalene, as measured at sample location LOPSL05, is the only PAH that exceeds both the residential- and industrial-based screening levels and is therefore selected as a COPEC.

Naphthalene is a low molecular weight, relatively soluble PAH with a high potential for natural degradation (volatilization and microbial degradation). It is not considered to be carcinogen and will not pose a significant non-cancer hazard because it is localized to an isolated spot. In addition, the sampled soil (located at the toe of the bluff) was associated with sloughing features; other material, as a result of on-going bluff erosion and high-energy wave action, will soon cover these soils. Naphthalene was detected in only one other surface soil sample collected along the bluff (26.7 µg/kg at LOPSL02). Based on a comparison to both residential and industrial exposure screening levels and SS83 site-specific considerations, naphthalene is not identified as a contaminant of ecological concern.

There was no surface water identified within the main portion of the SS83 site. The only surface water near the site, occurring as seeps along the shoreline, is not a current or potential future source of human drinking water. The discharge of potentially contaminated groundwater into Knik Arm may represent a possible point of future ecological exposure off-base. The most likely ecological exposure pathway by which indicator species could be significantly exposed to site contaminants is ingestion of contaminated water from these groundwater seeps. This exposure pathway is not considered significant at this time because no hazardous substances were detected in monitoring wells installed near the bluff, and any future contaminants that may discharge from the seeps will be quickly diluted. This exposure pathway is not assumed to be potentially complete at some time in the future because the majority of contaminant sources at the SS83 site will be removed by the selected removal action. Other future potential ecological risks are also likely to be minimized due to the extent of removal action objectives and alternatives identified and evaluated in Sections 3.0 through 5.0.



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### **3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES**

The purpose of this section is to establish the fundamental bases used to identify remedial action objectives. As described in the following paragraphs, the development of remedial action objectives is based on any statutory limits (cost value or time frame) applicable to implementation of the response actions; the overall scope, goals, and objectives of the removal actions; and the schedule for implementation of removal actions.

#### **3.1 Summary of Statutory Limits on Removal Actions**

The development of non-time-critical removal action alternatives follows the guidelines established by the EPA. The process is overseen by the USAF, EPA, and ADEC. Project managers from these agencies have agreed that, although the SS83 site poses a potential threat to human health and the environment, any removal action is non-time-critical.

The CERCLA, Section 104(c)(1), and the National Contingency Plan, 40 CFR 300.415, address non-time-critical removal actions. The duration and cost of Superfund-financed, non-time-critical removal actions are generally limited to \$2 million and 12 months. Any removal action resulting from this EE/CA will not be Superfund-financed and, therefore, is not subject to these constraints. It is anticipated, based on estimates provided in Section 4.0, that removal costs will not exceed \$2 million for the site. It is feasible that the removal action will be completed within a 12-month period. However, the removal action schedule will be determined by EAFB. In addition, an opportunity for public input in the EE/CA process of at least 30 days is mandated, as specified under CERCLA and the National Contingency Plan.

#### **3.2 Scope of Removal Action**

The results of the 2000 SS83 EE/CA field investigation, carried out at 10 distinct areas within the SS83 site, help define the scope of the possible removal actions and provide justification for implementing the selected removal actions. Investigation results indicate that surface and subsurface soil were impacted with bulk petroleum hydrocarbons (DRO and RRO), PAHs, and inorganic compounds (e.g., lead) at concentrations that may pose an unacceptable risk to human and ecological receptors. The petroleum hydrocarbon-based soil contaminants were limited to five areas within the site: LFA, BBA, SFA, LOP, and DBA, while the inorganic contaminants were limited only to soil at the former mechanic's pit at the MPA and possibly groundwater at the SFA.

Groundwater exceedances of Table C cleanup levels and background levels occurred for only arsenic, chromium, and mercury at SFA and DRO at BBA. At both the SFA and BBA, a soil removal action will likely also address groundwater by removing the presumed source of the groundwater contamination.

No volatile organic compounds (e.g., chlorinated solvents) were detected in samples collected from areas that would likely have been impacted (e.g., the mechanic's pit). Except at one location within the DKA, PCBs were not detected in field-screening and laboratory samples collected from areas that would likely have been impacted (e.g., around the perimeter of the large foundation). Although PCBs were detected during previous investigations at the LFA and DKA, PCBs have never been detected at levels that might pose an unacceptable risk.

A streamlined risk evaluation was conducted for both soil and groundwater, using the highest concentrations of hazardous substances remaining at the site, to help identify and evaluate potential removal actions for the site. The risk evaluation assessed the cumulative site risks associated with continued industrial use of the site under a no further action scenario. The streamlined risk evaluation determined that ADEC Method Two soil and groundwater cleanup levels are protective of site-specific human exposures expected for the site. Therefore, the Method Two (Tables B1 and B2; 18 AAC 75) cleanup levels used to characterize the site and evaluate removal actions are below ADEC cumulative site risk management criteria. Risks and hazards estimated using Method Two default residential exposures are conservative and therefore over protective of exposures expected under the future military/industrial scenario anticipated for the SS83 site. Therefore, these cleanup levels are established as the Applicable or Relevant and Appropriate Requirements (ARARs) for future removal actions at the SS83 site.

Although no adverse cumulative site risk was identified under the no further action assumption, contaminated soil with known concentrations of petroleum hydrocarbons above ARARs remains at several areas within the SS83 site. For example, bulk petroleum hydrocarbons are present at the LOP at concentrations up to 20,400 mg/kg DRO – in excess of Method Two cleanup levels designed to protect against adverse inhalation and ingestion exposures. As discussed in Section 2.3.2.1, the levels of petroleum hydrocarbons and PAHs in surface soil at other areas (BBA and SFA) are also in excess of migration-to-groundwater cleanup levels. Based on the results of the 2000 field investigation, fuel releases are believed to have occurred from two unregulated USTs discovered at the site. In addition, elevated levels of metals were detected in groundwater near the SFA. Using the site characterization information presented in Section 2.0, several removal action objectives have been developed.

### **3.3 Identification of ARARs and Other Criteria**

Removal actions at CERCLA sites must be protective of human health and the environment, and must also comply with all ARARs to the maximum extent practicable. As presented in this EE/CA, site characterization, risk estimates, and possible removal actions are evaluated using ADEC promulgated chemical-specific Method Two soil and groundwater cleanup levels. The ADEC cleanup criteria of the Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75) and UST Regulations (18 AAC 78) are considered ARARs for the site due to the petroleum-related contaminants found on site. The recommended removal actions presented in Section 6 of this document are anticipated to be final actions for the SS83 site with the exception of the landfill, which will be addressed in a later phase. As such, the selected

removal actions are intended to satisfy site closure requirements under ADEC's Contaminated Site Remediation Program.

Any removal action implemented at the SS83 site may also be required to comply with the substantive requirements of other federal and state standards. Examples include wildlife protection regulations (i.e., Endangered Species Act, Marine Mammal Protection Act, and Migratory Bird Treaty Act); hazardous materials and hazardous waste handling and transportation rules (40 CFR 170-199, 40 CFR 260-268); State of Alaska waste management regulations (18 AAC 60); and Occupational Safety and Health Administration requirements.

### **3.4 Schedule for Removal Action**

This subsection includes the general schedule for removal actions at the SS83 site, including both the start and completion times for the proposed non-time-critical removal actions. The anticipated activities and proposed schedule will be dependent upon public input and regulatory agency review of the SS83 EE/CA. However, removal actions discussed in this EE/CA are anticipated to occur in fiscal year 2003.

Following completion of the EE/CA, a Proposed Plan, written in an easy-to-read format, will summarize project activities, removal action alternatives, and proposed removal actions. The final Proposed Plan is expected to be available in November 2001. The public will be encouraged to read the final Proposed Plan, attend public meetings, ask questions, and offer comments. The decision by EAFB to select a removal action will be documented in an Action Memorandum. Included in the Action Memorandum will be the rationale for the selection and responses to comments and concerns raised during the public comment period. The final Action Memorandum is anticipated to be available in January 2002.

The start date for a removal action at the SS83 site is only influenced by Base operational constraints and available resources. Given the current site conditions (i.e., no adverse cumulative site risk), scheduling factors such as site prioritization, operational constraints, or resource allocation outcomes are not important criteria for establishing removal action objectives. In addition, none of the proposed removal action alternatives require considerable lead-time; therefore, the time required before implementing a removal action is not a significant factor.

### **3.5 Summary of Removal Action Objectives**

This subsection identifies the goals and objectives for a possible removal action at the SS83 site. At a contaminated site, where it is determined that a threat to public health, welfare, or the environment exists, a removal action may be taken to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release. Removal actions differ from remedial actions in that removal actions are generally more limited in scope and cost. However, a removal action does not necessarily mean only excavation with disposal; rather, removal alternatives can also include no further action, institutional controls, and in-situ treatment.

The removal action objectives for the SS83 EE/CA were developed to mitigate potential human health exposures. Based on the nature and extent of impacted soil and groundwater, the only specific chemicals of concern identified as a result of risk-based screening are arsenic, chromium, and mercury in one groundwater sample. Although the petroleum hydrocarbon indicator compounds measured at the site do not pose an unacceptable risk, a removal action may be warranted in order to mitigate potential adverse human and ecological health effects associated with high levels of bulk petroleum hydrocarbons in the surface and subsurface soils at the LOP. Furthermore, while not an immediate health threat and without considering the potential for natural degradation, continued contaminant migration at the site could pose a future health threat to either human or ecological receptors. Removing or permanently isolating hazardous substances detected at levels that may pose an unacceptable risk to human health or the environment is the primary removal action objective for the SS83 site. Removal actions may also be warranted in order to minimize the potential for further groundwater impact at the BBA and SFA.

The general removal action objectives for the SS83 site are as follows:

- Protect human health and the environment;
- Meet all ARARs and other applicable environmental criteria;
- Minimize any potential risks not characterized in the streamlined risk evaluation (e.g., ecological exposures); and
- Accommodate future land uses planned for the area.

The specific removal action objectives for the SS83 site are as follows:

- Remove bulk petroleum hydrocarbons from surface and subsurface soil at specific areas in order to eliminate potential ingestion- or inhalation-specific health risks.
- Remove bulk petroleum hydrocarbons from surface and subsurface soil in specific areas in order to minimize further migration of hazardous substances from unsaturated soils to saturated soils and possibly groundwater.
- Remove bulk petroleum hydrocarbons from surface and subsurface soil in specific areas in order to minimize potential exposures to sensitive ecological receptors.
- Minimize the impacts of waste management, transportation, and disposal.
- Obtain additional site characterization information if investigation results for a particular area are considered incomplete or insufficient.
- Incorporate current site controls and anticipated future land use considerations.



## **4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES**

In this section, a limited number of alternatives are identified and analyzed in order to determine whether a particular removal action alternative has the potential to successfully remediate site contamination and meet the removal action objectives identified in Section 3.0. These alternatives have been developed based on the nature and extent of contamination, streamlined risk evaluation, and specific removal action objectives identified for the SS83 site. The analysis or screening of alternatives is performed using the three general criteria of effectiveness, implementability, and cost as defined by EE/CA guidance (EPA 1993).

The effectiveness of an alternative refers to its ability to meet the removal objective within the scope of the removal action. The implementability of an alternative refers to the technical and administrative feasibility of implementing an action. If an alternative fails either the effectiveness or the implementability criteria, it will be eliminated from further consideration.

The relative cost of an alternative refers to the projected expenditures associated with direct and indirect capital costs and post-removal support or monitoring costs. Relative costs are provided for comparison purposes. Alternatives are not excluded based on cost alone.

### **4.1 Identification of Alternatives**

Alternatives were selected by identifying presumptive remedies or technologies that have been previously used at similar sites or for similar contaminants. By evaluating technologies that have been consistently selected and/or implemented at locations similar to the SS83 site, a presumption can be made that the particular alternative or set of alternatives is more likely to be appropriate for the specific site under evaluation. However, no removal action, even using the best available technology, can completely remove all contaminated material at the SS83 site. A removal action does not necessarily need to remove all contaminated material to below applicable cleanup levels; the primary goal of a removal action is to reduce the risk posed by the site.

The four identified alternatives are as follows:

- Alternative 1 – No Further Action
- Alternative 2 – Institutional Controls
- Alternative 3 – Removal with Disposal
- Alternative 4 – Treatment

#### **4.1.1 Alternative 1 – No Further Action**

No additional action in locating, removing, and disposing of site contaminants would be implemented under Alternative 1 (No Further Action). This alternative is included as a baseline case that represents the assumptions made in the streamlined risk evaluation. Under this alternative, no actions of any kind would be taken to remediate contamination at the site. Any areas of concern would be left in their current state. No monitoring activities or institutional controls would be performed, and the existing security gates and signs at the site would not be augmented.

##### **4.1.1.1 Effectiveness**

For the BBA, SFA, LOP, and DBA, Alternative 1 would not be protective of human health and the environment because no actions would be taken to reduce potential human health risks or potential groundwater impacts associated with elevated bulk petroleum hydrocarbons in soil in these areas of investigation or metals in groundwater measured at SFA. If no additional action were taken at these areas, degradation of petroleum hydrocarbons in soil through natural processes would still occur over a long period of time. In addition, large quantities of hazardous waste and petroleum-contaminated soils were already removed from the site because of test pit excavations.

Partly as a result of the 2000 field investigation activities, Alternative 1 would be protective of human health and the environment at the UBA, RVA, and DKA because these areas of investigation no longer contain contaminant concentrations at levels that pose a significant threat to public health or the environment.

##### **4.1.1.2 Implementability**

Alternative 1 is, by definition, easy to implement as no action is involved. There are no technical feasibility, availability, or administrative feasibility issues involved in the “No Further Action” alternative.

##### **4.1.1.3 Cost**

There are no costs associated with Alternative 1.

#### **4.1.2 Alternative 2 – Institutional Controls**

Instead of direct removal of site contaminants, institutional controls (site controls) rely on modifying human behavior and restricting access in order to reduce or eliminate risks and achieve ARARs. Behavior modification is an institutional control that relies on the personal responsibility of the site user. For example, an educational program would be required to warn the public (site workers and trespassers) of the location of site hazards. These institutional controls would involve using available resources (e.g., notices in printed media, brochures,

signs, and fencing) to facilitate awareness and training of the conditions and potential hazards and to alert site visitors of area-specific issues and concerns. Other more restrictive institutional controls may be possible at the SS83 site (e.g., prohibiting groundwater use as a drinking water source and/or restricting land use to a commercial/industrial nature). For institutional controls to be successful, the cooperation of local and state authorities and private interests is required.

#### **4.1.2.1 Effectiveness**

Alternative 2 does not reduce contamination or prevent migration of contaminated material. Toxicity at the site under Alternative 2 is the same as for Alternative 1 because site contaminants are not removed. However, the goal of institutional controls is to provide a means for the landowner (USAF) to reduce human health risks by limiting the duration and frequency of exposures at the site.

At the SS83 site, institutional controls may be effective as a stand-alone action. The use of fencing and signs to restrict access from small areas of particular concern (i.e., the LOP) can be sufficient to meet ARARs, but institutional controls are generally not effective when implemented in the absence of other actions.

#### **4.1.2.2 Implementability**

Restrictions to regulate access to and use of the SS83 site are currently in effect and, therefore, this alternative is easy to implement as no significant action is involved. The current and reasonably anticipated future land use is military/industrial. The feasibility issues associated with institutional control involve the physical aspects of ensuring that the controls remain intact and function as intended. The overall effectiveness of institutional controls depends on continued future implementation. Establishing institutional controls prohibiting the future use of site groundwater as a drinking water source would be an overly conservative measure because groundwater at the site is not a current nor reasonably anticipated future drinking water source.

#### **4.1.2.3 Cost**

Signs and security gates restricting access to the SS83 site are already present. Additional direct capital expenditures would be required to provide location-specific warnings and physical barriers (fencing) to specific areas of the SS83 site (i.e., the LOP) if any contaminated material remains. The costs associated with implementation of this alternative are low and would be significantly less than any other removal action alternative except Alternative 1. Further, the costs would be incorporated into existing institutional control programs at EAFB.

### **4.1.3 Alternative 3 – Removal with Disposal**

Alternative 3 includes the removal of surface and subsurface soil impacted by site contaminants at levels above Method Two ingestion- or inhalation-specific cleanup levels and migration-to-groundwater cleanup levels. The excavations, to a maximum depth of approximately 15 feet

bgs, are designed to reduce human and ecological exposures and minimize the potential for migration of contaminated soils. Removal of impacted soil will also likely serve to reduce or eliminate the source of future groundwater contamination via the migration-to-groundwater pathway.

Experienced personnel using field-screening and analytical laboratory sampling would coordinate soil removal activities at the site. Excavations would be backfilled with clean fill. Institutional controls could be implemented in combination with this alternative to further decrease the estimated duration and frequency of human exposures. Selective soil removal would also likely reduce any potential ecological risks associated with site contaminants. Any excavated soil containing levels of petroleum hydrocarbons greater than the applicable cleanup levels would be transported off site and thermally remediated.

Based on the nature and extent of contaminants identified in Section 2.0, selective soil removal activities are expected for the BBA, SFA, LOP, DBA, and possibly at the MPA.

Two USTs were discovered at the LFA during the 2000 field investigation; Alternative 3 includes removal of these USTs in accordance with ADEC UST Regulations (18 AAC 78; ADEC 2000b). Based on the results of ADEC matrix scoring (provided in Appendix I), the tank removal action may require the removal of petroleum-impacted soils using Method One Category B cleanup levels.

A suspected landfill (LND area) was discovered in the northwest portion of the site. Based on the limited site characterization data obtained during the 2000 EE/CA field investigation, it is believed that construction debris associated with decommissioning of the former AAA site may be buried in the area. Alternative 3 includes the removal of buried debris and/or potentially contaminated material located in areas adjacent to the bluff. This removal would minimize the potential for future exposures due to shoreline erosion and bluff regression.

#### **4.1.3.1 Effectiveness**

This removal action alternative would result in removal of some of the site contaminants and would help achieve applicable cleanup levels. The removal of soil at the LOP would immediately protect human health and the environment. Removal of other site contaminants may also reduce long-term risk to human and ecological receptors associated with exposure to subsurface soil and/or groundwater.

Excavation of localized contaminated material is generally practicable where the contaminants are in discrete, accessible locations. The area of proposed excavation should be large enough that the removal would significantly reduce the risk posed by the material (including migration to groundwater), but small enough that it is reasonable to consider the removal action.

#### **4.1.3.2 Implementability**

In May 2000, in preparation for field investigation activities, the main portion of the SS83 site was hydro-axed and cleared of brush. Although some undergrowth revegetation is expected to occur at the site, the area is currently well cleared and is expected to remain so for some time.

Off-site disposal of remedial wastes is also feasible. Off-site disposal can be accomplished by transporting contaminated soil an ADEC-approved thermal treatment facility.

#### **4.1.3.3 Cost**

The costs for excavation are considered to be moderate, but will depend on the lateral and vertical extent of excavations. The costs for disposal (including thermal remediation at an ADEC-approved facility) are also considered to be moderate; however, costs escalate quickly if hazardous wastes were encountered. A cost of \$10,000 to \$20,000 per area (e.g., BBA, SFA) is estimated for soil excavation and thermal remediation.

#### **4.1.4 Alternative 4 – Treatment**

Treatment (Alternative 4) refers to the use of in-situ treatment technologies to remediate contaminated soils without excavation. In-situ treatment alternatives can include stabilization (capping/protective barriers), soil heating, soil vapor extraction, bioventing, and natural attenuation. Based on the nature and extent of contamination at the SS83 site, remediation by natural attenuation (RNA) is considered the most practicable treatment alternative. RNA, sometimes referred to as intrinsic bioremediation, would reduce the mass and concentration of petroleum hydrocarbons in the environment to levels protective of human health and the environment. Intrinsic bioremediation by indigenous soil microorganisms is one of the primary mechanisms for natural attenuation. Under Alternative 4, RNA processes (such as biodegradation, dispersion, dilution, volatilization, hydrolysis, adsorption, and other abiotic chemical processes) are used to reduce petroleum hydrocarbon constituents to levels that satisfy removal action objectives. Data from field studies, laboratory studies, and other research have demonstrated that natural attenuation can significantly limit the migration of contaminants resulting from releases of petroleum hydrocarbons.

##### **4.1.4.1 Effectiveness**

Over a long period of time, RNA is effective at reducing risks associated with exposures to contaminated soils and reducing contaminant concentrations to applicable levels. RNA has been demonstrated to be a feasible remedial alternative for unsaturated and saturated soil contamination at EAFB (USAF 1994, AFCEE 1994), where human and ecological exposures to contaminated groundwater are unlikely. However, the RNA alternative presumes that contaminants will degrade before future land uses change. In addition, contaminants may migrate off-site before they are degraded or transformed. As a result, further information regarding the probable extent and duration of contaminant migration and potential groundwater

impacts may be necessary to evaluate the likelihood that RNA is capable of minimizing future human or ecological exposures at the SS83 site.

#### **4.1.4.2 Implementability**

Implementation of RNA requires a demonstration of remedial progress and attainment of removal action objectives. The primary confirmatory evidence for RNA is provided by observed reductions in contaminant concentrations at the site. Secondary evidence is provided by evaluating geochemical indicators in order to establish that naturally occurring degradation is feasible. Much of this information may have already been collected for the SS83 site as a result of the 2000 SS83 EE/CA field investigation. Optional lines of evidence can also be provided by microbiological information or fate and transport modeling. A modeling effort, using both site-specific and non site-specific input parameters, may be required to:

- predict expected naturally occurring biodegradation and attenuation rates;
- predict petroleum hydrocarbon constituent concentrations in groundwater, based on observed soil concentrations; and
- calculate a lower-bound soil cleanup level (based on risk-based concentrations) specific to potential ecological exposures along the bluff.

Because no model results can provide an exact prediction of future concentrations at the site, an on-going monitoring program may also be required to provide information to support implementation of RNA.

#### **4.1.4.3 Cost**

The cost for RNA is generally low. When required, modeling and long-term monitoring activities increase costs substantially. Costs for a sitewide treatment alternative are therefore anticipated to be high, but possibly comparable to costs associated with extensive implementation of Alternative 3. On an SS83-wide basis, a cost of \$100,000 to \$200,000 is estimated for implementation of modeling and long-term monitoring associated with RNA.



## 5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

In the preceding section, response action alternatives were evaluated in terms of the criteria of implementability, effectiveness, and cost. The comparative analysis presented in this section builds upon the preceding evaluation utilizing the same criteria of effectiveness, implementability, and cost, but examining the performance of the removal action alternatives in relation to each other. The action alternatives are compared under each criteria in order to determine which alternative is the most suitable given the unique site characteristics of the contamination areas of investigation. The results of the comparative analysis (provided in Table 5-1) are discussed in the following sections.

### 5.1 Effectiveness

In general, No Further Action (Alternative 1) is not an effective alternative compared to Institutional Controls (Alternative 2), Soil Removal with Disposal (Alternative 3), or Treatment (Alternative 4) because no actions are taken to either reduce exposures or remove site contaminants. However, many of the field investigation activities conducted at the SS83 site during 2000 resulted in the removal of contaminated soil. Based on the site characterization data presented in this EE/CA, sufficient documentation is available to support a determination that there are no hazardous substances at either the UBA, RVA, or DKA that could cause adverse impacts to human health or the environment. Alternative 1 is effective for these areas.

Although treatment using RNA (Alternative 4) is expected to effectively degrade site contaminants to acceptable levels over a period of time, selective removals of contaminated materials with appropriate disposal (Alternative 3) will provide more effective long-term protection of human health and the environment.

Institutional Controls (Alternative 2) are generally of limited effectiveness when implemented in the absence of other actions, such as Alternative 3; however, they are very useful when combined with more active removal actions. If properly enforced and established in combination with either Alternative 3 or Alternative 4 actions, Institutional Controls can effectively increase the protectiveness and durability of these removal actions. The benefits of Institutional Controls would likely be maximized if implemented uniformly throughout the SS83 site, consistent with the undeveloped setting and anticipated future industrial use at the site.

### 5.2 Implementability

No Further Action, Institutional Controls, Removal with Disposal, and Treatment actions are all implementable with certain constraints. The relative implementability of each depends upon matching one or more of the various possible actions to the particular conditions found at the different areas of investigation.

Removal with Disposal is inherently more rapid than Treatment in achieving risk reductions and satisfying ARARs; however, given the localized constraints at the LOP and the LND, a decision to employ natural attenuation as a removal action or component may be appropriate in these areas. Very little additional site-specific data is required in order to implement an RNA cleanup component. Much of the information required to implement RNA (ADEC 2000f) has already been obtained, such as a quantitative understanding of source mass, groundwater flow, hydrogeological soil properties, contaminant phase distribution and partitioning, and geochemical indicator levels. Modeling is likely to be necessary to understand how all these contaminant behavior factors vary over time. At a minimum, verification of the natural attenuation process would require monitoring of petroleum hydrocarbon concentrations to document reductions in soil.

### **5.3 Cost**

The relative costs of removal actions will generally vary depending upon the scope of the actions implemented at the SS83 site. For example, the costs will vary depending upon:

- the physical components and degree of institutional controls established;
- the lateral and vertical limits of excavations;
- the transportation and disposal costs associated with soils impacted only by petroleum versus soils determined to be hazardous waste; and
- the extent of modeling and/or monitoring associated with an RNA treatment approach.

Estimated costs for Alternative 1 and Alternative 2 are negligible. The implementation of institutional controls would be covered by programs already in place for EAFB. Best estimate costs for Alternative 3 range between \$50,000 to \$120,000 (total cost implemented at BBA, SFA, LOP, DBA, and possibly MPA). Best estimate costs for Alternative 4, implemented throughout the SS83 site instead of Alternative 3, range from \$100,000 to \$200,000.

Table 5-1. SS83 EE/CA - Comparative Analysis of Removal Alternatives.

REMOVAL ALTERNATIVE	EFFECTIVENESS					IMPLEMENTABILITY					RELATIVE COST
	Overall Protection of Public Health and the Environment	Compliance with ARARs and Other Criteria, Advisories, and Guidance	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Technical Feasibility	Administrative Feasibility	Availability of Services and Materials	Agency Acceptance	Community Acceptance	
Alternate 1: No Further Action	Does not satisfy removal action objectives.	Does not immediately satisfy existing ARARs at several areas of investigation.	Degradation of petroleum hydrocarbons effective over a long period of time.	Provides reduction in contaminant mobility and volume due to natural degradation processes.	No short-term effectiveness.	Very feasible.	No administration required.	No services or materials required.	Unlikely - except at UBA and RVA.	Unlikely - except at UBA and RVA.	None.
Alternate 2: Institutional Controls	Does not satisfy removal action objectives unless established in conjunction with either removal and/or treatment actions.	Satisfies ARARs if fencing, signs, and other behavior modification techniques are adequately established.	Limited effectiveness and permanence of risk reduction; requires continued future implementation; natural degradation of petroleum hydrocarbons over a long period of time.	Reduces potential human exposures but does not reduce contaminant concentrations or minimize migration potential except by natural degradation processes.	Limits frequency and duration of human exposures to site contaminants.	Feasible for on- base contamination as long as EAFB maintains control over land use; not feasible for off- base contamination.	Some site controls already in place. Limited additional administration required to ensure maintenance of physical controls.	Services and materials readily available.	Likely - after consultation with site landowner and government agencies.	Likely - after consultation with site landowner and government agencies.	Low.
Alternate 3: Removal with Disposal	Satisfies all removal action objectives.	Expected to satisfy ARARs.	Effectiveness is a function of lateral and vertical extent of removal.	Significantly reduces migration potential and volume of contaminated material.	Eliminates potential human and ecological exposures to contaminated surface soil.	In general, very feasible, however excavations greater than 10-15 feet may not be feasible near bluff due to slope instability.	Requires coordination with site users, limited administration to ensure maintenance of physical controls, and development of cleanup plan and work clearance request.	Services and materials readily available.	Very likely.	Very likely.	Moderate.
Alternate 4: Treatment	Satisfies all removal action objectives when combined with institutional controls.	Expected to satisfy chemical-specific ARARs.	Long-term effectiveness maximized when combined with institutional controls, modeling, and monitoring.	Degradation of petroleum hydrocarbons in soil effective over a long period of time; reduction in availability documented through monitoring.	Limited short- term effectiveness when combined with institutional controls.	Feasible.	Requires coordination with site users, development of cleanup plan, and work clearance request.	Services and materials readily available.	Likely - after consultation with site landowner and government agencies.	Likely - after consultation with site landowner and government agencies.	High.

## 6.0 RECOMMENDATIONS AND CONCLUSIONS

The detailed and comparative analyses presented in Sections 4.0 and 5.0 of this EE/CA have demonstrated that, depending on the area of investigation, one or more of the identified removal action alternatives would be considered protective of human health and compliant with ARARs, as well as implementable, effective, and generally cost-effective. These detailed and comparative analyses have thus provided the basis for developing a comprehensive cleanup action that is designed for the specific conditions at each area of investigation and that satisfies the removal action objectives.

Based on effectiveness and feasibility, it appears that Removal with Disposal (Alternative 3) and Treatment (Alternative 4) are both capable of satisfying the removal action objectives applicable to the SS83 site. No Further Action (Alternative 1) and Institutional Controls (Alternative 2) are appropriate for the UBA and RVA, but not for any other area of investigation.

In order to select between Alternatives 3 and 4, site-specific conditions, site priority issues, and resource availability were considered. It is expected that Alternative 3 actions will be more effective than Alternative 4 actions in removing subsurface contamination in the shallow unsaturated zone, particularly in the short-term.

While implementation of Treatment action is expected to be effective in reducing the concentrations of hazardous substances at the site, a Treatment action would not be able to satisfy ARARs as cost-effectively. Potential migration from the subsurface into groundwater and to surface water through groundwater seeps would also be better mitigated by Removal with Disposal actions. However, if it is determined that site constraints at either the LOP or the LND reduce the effectiveness of Removal with Disposal or increase the implementation costs of such an action, then an in-situ Treatment action may become more cost-effective.

Ultimately, it will be necessary to demonstrate that the final removal actions, once implemented, will in fact address all pathways and contaminants of concern, not just those that triggered the removal action.

### 6.1 Recommendations

The recommended removal actions are presented below for each area of investigation.

#### 6.1.1 Drum Bunker Area

The DBA is located southeast of the Rosette Antenna near the entrance to the SS83 site. Based on reconnaissance geophysical survey results, a test pit was excavated in the center portion of the drum bunker area where buried metal debris was indicated. The test pit was excavated to a depth of approximately 10 feet, but no debris was encountered. As discussed in Section 2.3, analytical results indicate the presence of DRO/RRO in surface soils at levels

greater than ADEC migration-to-groundwater soil cleanup levels. However, this result may indicate a localized impact since no significant contamination was encountered in six additional test pits excavated throughout the bunker area. A very limited Removal with Disposal action (Alternative 3) is recommended to remove an estimated 5 cubic yards (cy) of surface soil within the center of the bunker.

### **6.1.2 Large Foundation Area**

Two USTs were discovered at the LFA during the 2000 EE/CA field investigation. The tanks probably stored diesel fuel for the former building's heating system. UST 1, approximately 500 gallons in size, was located during excavation of a test pit along the west side of the foundation. A second test pit was excavated along the southeastern side of the foundation, where another tank (UST 2; approximately 1,000 gallons in size) was located. Following removal of the liquids contained in the tanks, the tanks were left in place and the test pits were backfilled with clean fill.

Evidence obtained from the 2000 EE/CA field investigation indicates that petroleum was released from both USTs (see Section 2.2.2). Petroleum hydrocarbon-impacted soils were encountered at depths ranging between 2 to 17 feet bgs. The groundwater level was encountered at approximately 17 feet bgs when three monitoring wells were installed in the area. Bulk petroleum hydrocarbons were not detected in water samples collected from these wells.

Alternative 3 is recommended for the LFA: both unregulated USTs should be permanently closed. No specific time limit for closure of an out-of-service tank is specified in 18 AAC 78. The tank removal action would include excavating contaminated soil to a depth of approximately 15 feet bgs or to groundwater. Both tanks are situated near the edge of the large foundation; the southern portion of the foundation may need to be removed in order to access impacted soil located west of UST 2. Based on the site characterization to date, the total volume of soil that may require removal and treatment is estimated at approximately 25 cy. Based on additional soil sampling data to be collected during tank removal activities, additional soil may need to be removed to minimize risks to human health and the environment or to meet applicable cleanup levels. During UST removal, it may be beneficial to trench along the north edge of the LFA foundation to determine whether a floor drain discharge pipe extends from this side of the building.

### **6.1.3 Motor Pool Area**

A mechanic's pit existed at the west end of the foundation at the MPA. Test pit MPATP01 was excavated to encompass the mechanic's pit; material encountered in the pit included oil cans, oil filters, automotive parts, miscellaneous solvent containers, and other construction debris.

Approximately 10 cy of contaminated soils and debris were removed from within the mechanic's pit during excavation of MPATP01. As discussed in Section 2.2.3, analytical results indicated

that the material contained significant amounts of DRO, RRO, BTEX, PAHs, and metals. This material was turned in to EAFB as a hazardous waste due to high concentrations of chromium and lead.

Monitoring well MPAWL01 was installed at the mechanic's pit where test pit MPATP01 had been excavated. The boring was drilled to a depth of approximately 24 feet bgs. Because the area had been previously backfilled, no soil samples were collected until approximately 16 feet bgs. The shallowest soil boring sample (MPAWL01SO16.6N1) was collected from a 2-foot interval beginning at approximately 17 feet bgs. Metals analyses were not conducted for this sample, but petroleum hydrocarbons were not detected above their respective method quantitation limits (MQL) indicating that the extent of contamination is probably limited to that depth. As discussed in Section 2.3.2.1, the levels of chromium and lead measured in water samples collected from the two downgradient wells nearest the mechanic's pit do not exceed the groundwater cleanup levels applicable to the SS83 site (i.e., Table C values) and also fall within the range of naturally occurring metal concentrations for the Anchorage region presented in Section 1.6.2 (see Table 1-2).

Although the majority of highly contaminated soils and debris located within the mechanic's pit were removed as a result of test pit MPATP01, some contaminated soil may remain within an interval between 10 to 17 feet bgs. No analytical samples were collected from this interval, so the actual levels of contamination are not known. However, based on the test pit sample results collected just above this interval, it is possible that contaminant concentrations exceed ADEC Method Two inhalation-specific, ingestion-specific, or migration-to-groundwater cleanup levels.

The petroleum hydrocarbons and metals possibly remaining beneath the pit are not expected to contaminate groundwater in the area based on a comparison of test pit sample results to ADEC Method Two migration-to-groundwater soil cleanup levels. In addition, any remaining petroleum hydrocarbons in the subsurface soil are expected to degrade over time through natural attenuation processes. However, as a conservative measure, Alternative 3 is recommended at the MPA. The potentially impacted soils remaining beneath the mechanic's pit (between 10 to 17 feet bgs) could be removed. Based on the estimated interval of impacted soils, the total volume of soil that could be removed and disposed is estimated at less than 10 cy. Further excavation beneath the former mechanic's pit may require removal of the western portion of the motor pool foundation.

#### **6.1.4 Suspected Landfill Area**

As described in Section 2.2, the very limited investigation at the LND indicates at least two areas where landfill activities are suspected to have occurred. Significant amounts of what appeared to be construction debris were encountered during the field investigation. Only DRO and RRO were detected within the area; although these levels are below Method Two cleanup levels, additional contamination may exist in the area.



A review of the collective information obtained from the 2000 EE/CA field investigation indicates that additional site characterization data are needed in order to identify the nature and extent of contamination at the LND. The need for further investigation is largely due to the proximity of buried debris and potentially contaminated material to the bluff and shoreline of Cook Inlet.

Site characterization for suspected landfills can be expedited by focusing future field activities on the information needed to sufficiently assess risks posed by the site and to evaluate practicable removal actions. For example, characterization of a landfill's contents is generally not necessary because containment of the landfill's contents, which is often the most practicable technology, does not require such information. Further information is needed, however, regarding the suspected landfill's properties – such as fill thickness, lateral and vertical extent, and age. This information will help identify settlement and leachate generation rates, which will have an influence on the removal action appropriate for the area. For example, lateral migration of shallow groundwater from the landfill to the bluff could be restricted by creating a trench-type barrier filled with composite-cap material. Similarly, the type of trench will be dependent on the nature of the contaminant to be contained.

Geotechnical data gathered near the area was similar to that collected at other areas within the site. Therefore, further information on the LND's geology and hydrogeology may not be required. This information will also affect decisions on removal action (containment or capping) including extraction and treatment systems for leachate and groundwater if necessary. At this time, given the limited information available for the area, additional site investigation is recommended. Characterizing the potential for precipitation, surface water, and/or shallow groundwater to generate contaminated leachate will be of special concern when investigating the suspected landfill area. It should be noted, however, that without the proper precautions, placing test pits or wells into landfill contents may create health and safety risks. As such, further characterization of the suspected landfill area using high-resolution electromagnetic and magnetic surveys, including ground-penetrating radar, is strongly recommended.

#### **6.1.5 Small Foundation Area**

Petroleum-impacted soil was encountered at surface and subsurface locations within the northern portion of the SFA. As described in Section 2.2.5, the source is believed to be historical surface releases. Elevated concentrations of DRO, RRO, and the noncarcinogenic PAHs naphthalene and phenanthrene were measured between 3 to 13 feet bgs. As discussed in Section 2.3.2.1, only the levels of DRO in this area are in excess of ADEC migration-to-groundwater soil cleanup levels. Three monitoring wells were installed to the north and one monitoring well was installed to the west of the SFA in the presumed downgradient direction; groundwater was regularly encountered between 17 and 19 feet bgs. Only one water sample, collected from monitoring well SFAWL03 approximately 25 feet downgradient from the small foundation, contained petroleum constituents. The levels measured were below ADEC groundwater cleanup levels (see Section 2.3.2.1). Certain metals (arsenic, barium, cadmium, chromium, and mercury) measured in groundwater samples collected at SFAWL01 and

SFAWL02 at levels in excess of cleanup levels and background concentrations should be further investigated.

The petroleum hydrocarbons detected are attributable to historical releases; chromatograms indicate the petroleum hydrocarbons are very weathered. The petroleum hydrocarbons in this area may be expected to further contaminate groundwater in the area. It is not known whether the petroleum hydrocarbons have exhausted the potential for future groundwater impacts. However, any remaining petroleum hydrocarbons in the subsurface soil are expected to continue degrading over time through natural attenuation processes. Although unlikely, the nature of metals measured in groundwater may also be attributable to historical releases at SS83.

Alternative 3 is recommended to remove the impacted soils located north of the SFA to a maximum depth of approximately 15 feet bgs. Based on the lateral and vertical extent of impacted soils located within these areas, the volume of soil that may require removal and treatment is estimated to be approximately 20 cy. The small foundation may need to be removed in order to access impacted soil beneath it. Further characterization of metals in soils and groundwater during excavation would clarify whether elevated metals in groundwater are naturally occurring or related to historical activities at the site.

#### **6.1.6 Bermed Bunker Area**

A presumed historical surface release was also discovered along the southwest corner of the concrete pad at the BBA. A fuel line was encountered just below the surface, oriented in an east-west direction. It appeared that the fuel line had once been connected to both the BBA and SFA. As discussed in Section 2.2.6, elevated levels of GRO, DRO, RRO, and the carcinogenic PAH chrysene were measured. Only the levels of DRO are in excess of ADEC migration-to-groundwater soil cleanup levels (see Section 2.3.2.1). Two monitoring wells were installed in the BBA, and groundwater was encountered during drilling at 19 feet bgs. Water samples collected from the monitoring well nearest the small foundation (BBAWL01) indicated the presence of DRO at an elevated concentration, greater than the Table C groundwater cleanup level.

Test pit BBATP06 was excavated between the former bermed bunker wall and the edge of the concrete pad. Based on the soil sample results from this test pit and monitoring well BBAWL01, contamination in this area extends from the surface to approximately 22 feet bgs. However, the majority of contamination appears to be limited to depths of 15 to 17 feet bgs. The lateral extent of impacted soil is limited to the north by BBATP05 and to the south by BBATP01. Petroleum-impacted soil at this location extends westward toward the SFA. Test pit SFATP04, excavated between the bermed bunker and small foundation areas indicated petroleum-impacted soils to at least 10 feet bgs.

The petroleum hydrocarbons in this area may also be expected to further contaminate groundwater in the area. Similar to the SFA, it is not known whether the petroleum

hydrocarbons have exhausted the potential for future groundwater impacts. However, any remaining petroleum hydrocarbons in the subsurface soil are also expected to continue degrading over time through natural attenuation processes.

Alternative 3 is recommended to remove the impacted soils located west of the BBA to a maximum depth of approximately 15 feet bgs. Based on the lateral and vertical extent of impacted soils located within these areas, the volume of soil that may require removal and treatment is estimated to be approximately 20 cy. Removal of remaining petroleum hydrocarbon-impacted soil will also likely serve to reduce or eliminate the source of future groundwater contamination via the migration-to-groundwater pathway.

#### **6.1.7 Underground Bunker Area**

Based on the results of this EE/CA, no further action is recommended for this area.

#### **6.1.8 Ravine Area**

Based on the results of this EE/CA, no further action is recommended for this area.

#### **6.1.9 Docking Area**

Based on the results of this EE/CA, no further action is recommended for this area.

#### **6.1.10 Lookout Pad Area**

The LOP is located west of the DKA along the bluff looking out over the Knik Arm of Cook Inlet. The shoreline and tide flat habitat below the bluff is considered a sensitive ecosystem. Materials remaining in the area (e.g., concrete foundation, tie-down anchor points, and a segment of fuel piping between the lookout pad and the docking area) indicate that the pad may have served as a foundation for an aboveground storage tank.

Evidence of petroleum impact was encountered at the LOP in test pits, soil borings, and bluff surface samples. As discussed in Section 2.2.9, analytical results for soil samples collected north of the pad indicate that the petroleum-impacted soils extend to 10 feet bgs. Very high levels of DRO in excess of Method Two ingestion- and inhalation-specific cleanup levels (as well as ADEC maximum allowable levels) are present near the bluff edge (see Section 2.3.2.1). Petroleum hydrocarbon-contaminated soil is also present along the bluff face possibly due to contaminant migration. It is more likely, however, that the petroleum hydrocarbons present along the bluff face may simply have been exposed due to shoreline erosion and bluff regression.

Site conditions indicate petroleum hydrocarbons currently in the unsaturated soil zone may migrate to groundwater. There is a potential that contaminants at the LOP could migrate on top of the shallow groundwater table and seep along the bluff. Groundwater seeps are located in this area, but petroleum hydrocarbon constituents were not detected above MQLs in water

samples collected from two monitoring wells installed at the LOP. To minimize the potential spread of petroleum hydrocarbons to Cook Inlet and significantly reduce the potential threat to human and ecological receptors, a limited removal action may be appropriate.

Alternative 3 is recommended for the LOP, limited to depths of 10 feet bgs. An excavation volume of 20 cy is estimated based on the site characterization to date.

## **6.2 Conclusions**

In summary, chemical, geophysical, and hydrogeological data collected during the 2000 SS83 EE/CA field investigation were used to characterize the SS83 site. Based on the site characterization, this EE/CA balanced the risk reduction (effectiveness), technical concerns (implementability), and cost-effectiveness of several removal action alternatives in order to select the recommended removal actions described above. In summary, the recommended removal actions for the individual areas within the SS83 site are risk-based (designed for the protection of human health and the environment); compliant with ARARs (designed to achieve applicable ADEC soil and groundwater cleanup levels); and preserve the site for future military/industrial use. These removal actions are expected to meet ADEC site closure requirements.

After a public comment period on the EE/CA and a Proposed Plan, the USAF will consider the comments and select a removal action for the site. The decision will be documented in an Action Memorandum that presents the selected alternative, explains the rationale for the selection, and provides responses to comments and concerns raised during the public comment period.

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